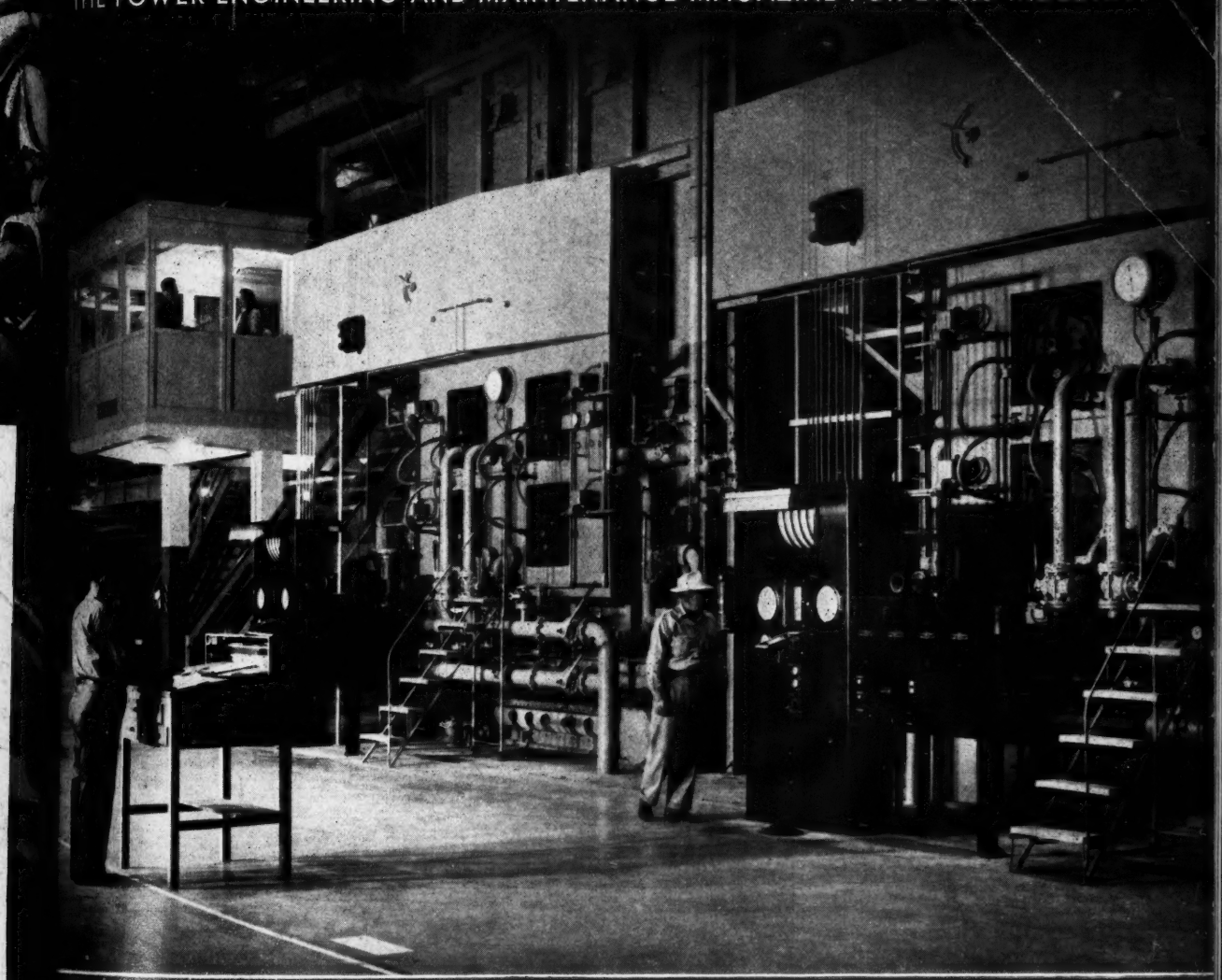
POWER PLANT ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

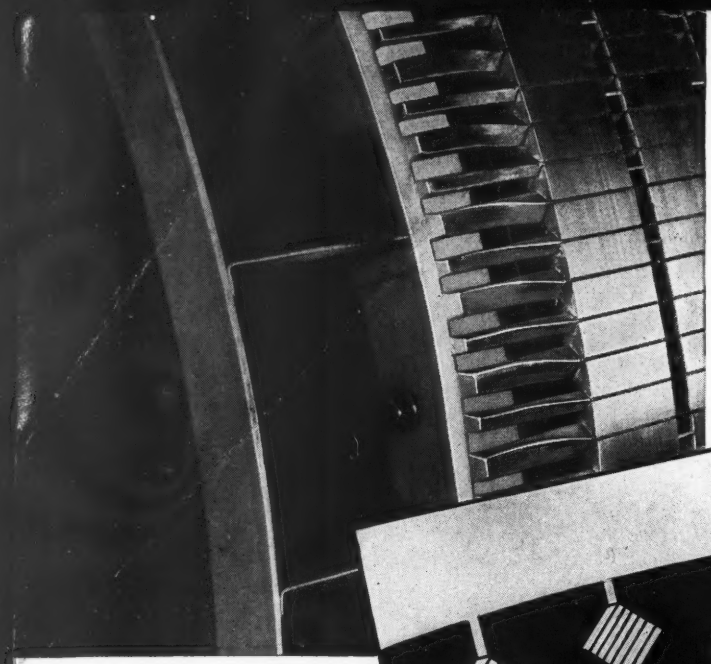


TECHNOLOGY DEPT.

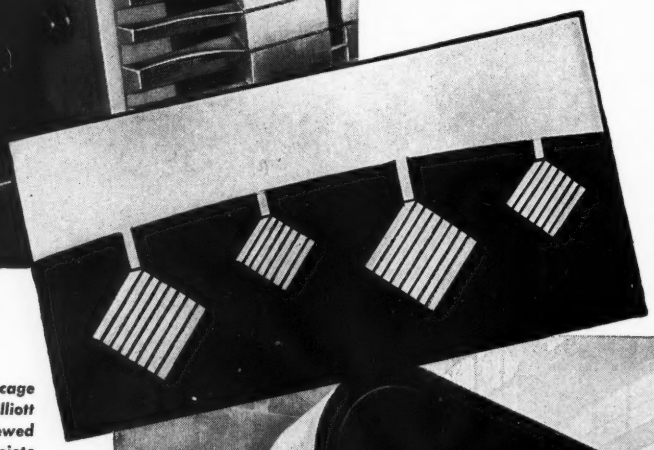
Bayside Station 1927-1943
How To Make Transformers Do More Work
Building A Power House On A River Bank
More About Gas Turbine Prospects
The Park Avenue Noise Mystery

For Other Articles See Contents Page 5

APRIL 1944



Elliott

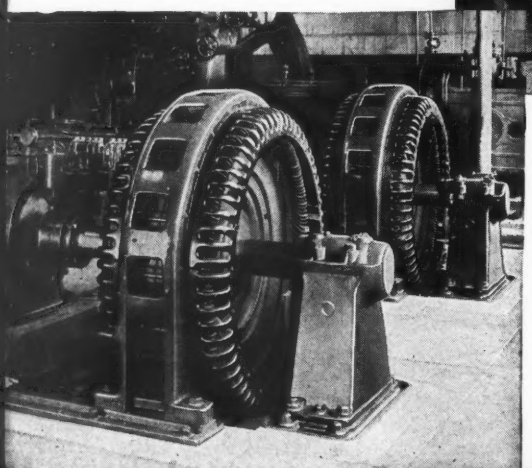


Detail of diamond cage arrangement, showing comparatively broad area, and consequent strength, of laminations.

At top: Close up of diamond cage construction as developed for Elliott squirrel-cage motors. The skewed formation of the bars assists mechanical stiffness.

At right: One of a large number of Elliott 6600-hp. synchronous motors for tanker propulsion. These motors have Elliott diamond cage winding. Photo shows motor completely covered, with its ventilating system. (In these vessels, Elliott furnishes also the main and auxiliary turbine-generators, desuperheaters, mechanical drive turbines.)

Below: Two Elliott engine-type synchronous motors driving compressors. Superintendent in this plant says these are the quietest motors he has ever seen.



ELLIOTT

ECHNOLOGY DEPT

engineering advances motor design

ELLIOTT DIAMOND CAGE CONSTRUCTION

- Achieves high starting torque, low starting current in A. C. motors—
- Small pole horns required reduce leakage flux in synchronous motors—
- Combines the most desirable ratio of cage resistances with the most favorable relation of cage reactances—
- Allows close nesting of bars with smallest sacrifice of strength of the iron section between bars—
- Affords means of eliminating all looseness between rotor stack and bars—
- Gives exceptional strength, and stiffness of the tip of stack—
- Combined with other structural features assures unusually quiet operation.

Ingenious engineering is characteristically Elliott. Tough problems which must be solved in new ways, are an interesting challenge to Elliott engineers, who are constantly designing special equipment for the individual job. Through this activity Elliott engineers have amassed facts and data of immense value, and have gained the habit of original thought which is an essential of all pioneering in any phase of human endeavor.

A case in point is the development by Elliott engineers of "diamond-cage" construction in squirrel-cage motor design. On the sound basis of overall results and long-term performance, we believe this construction is superior among the many efforts of motor designers to meet the requirements in this problem.

Full details of this development, including graphs of comparative tests, and data on the motors of which it is a part, may be had at request.

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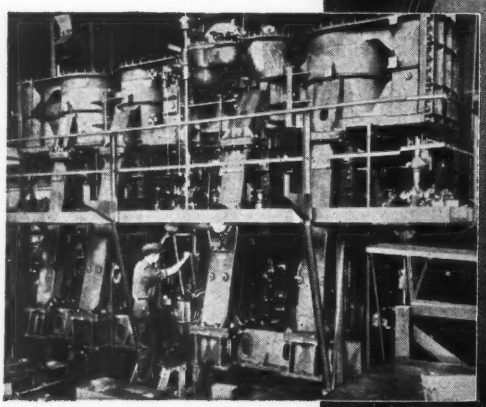
Electric Power Department, **RIDGWAY, PA.**

DISTRICT OFFICES IN PRINCIPAL CITIES

L-749

builds fine motors

LAY THAT PISTON DOWN



CALLED upon to break the motive power bottleneck of America's ship-building program, reciprocating steam engines have come into use in unprecedented numbers.

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Published Monthly by
TECHNICAL PUBLISHING CO.
53 W. JACKSON BLVD.
CHICAGO 4, ILL.

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Contents, April, 1944

VOLUME 48—NUMBER 4

Cover: A view in the boiler room of the Douglas Aircraft plant at Oklahoma City. This plant is described on page 80 of this issue.

Front Lines 7

What Leaders Say 61

Continuous Troffer Lighting 62

With the Editors 63

Bayside—Simple and Progressive in 1943 as in 1927 64

The Gas Turbine—Present Status and Immediate Prospects 70
By C. Richard Soderberg and Ronald B. Smith

How to Make Your Transformers Do More Work 76
By H. L. Cole and L. W. Smith

Engineering Services for a Controlled-Conditions Plant of Douglas Aircraft Co. 80
By A. D. Engle and W. W. Frankfurt

Problems in Building a Power House on the Bank of the Ohio River 85
By W. H. Hartman

Guarding Grand Coulee Against Fire 89
By D. A. Diehl

The Practical Engineer and Electrician 91

Reinforced Concrete Pipe 134
By Wm. A. Shelton

Post-War Employment 136

New Equipment 140

Manufacturers' Personals 162

Manufacturers' News 170

News from the Field 174

Helpful Bulletins 185

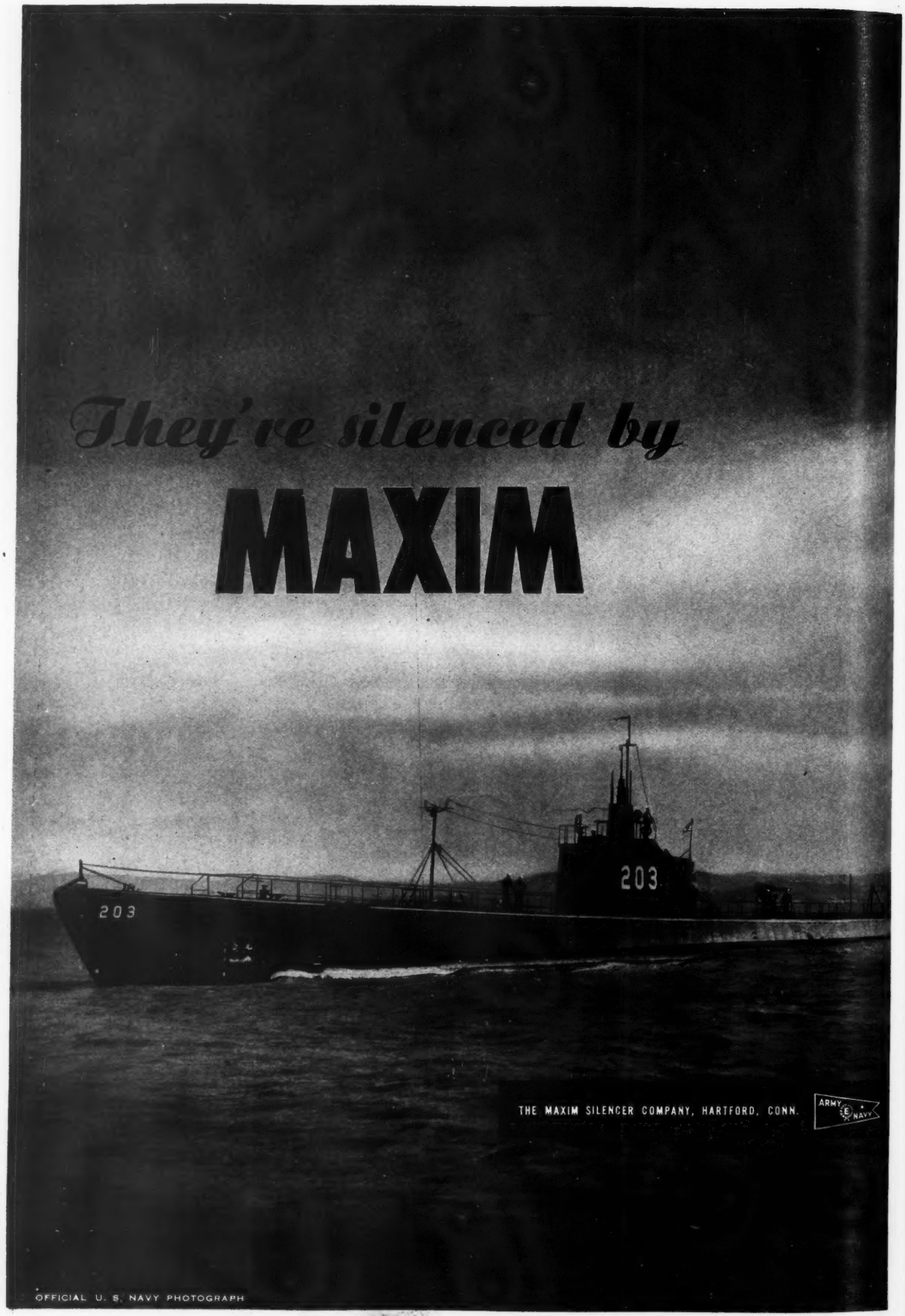
New Engineering Books 192

Power Plant Construction News 198

Contents of back issues of Power Plant Engineering will be found in Industrial Arts Index on file in Public Libraries.

Copyright 1944, by Technical Publishing Co.

Published monthly by the Technical Publishing Co., at 53 West Jackson Blvd., Chicago 4, Ill., U. S. A. Subscription price, $2.00 a year. Single copies current issue, 25c. Entered as second class matter September 8, 1932, at the Post Office, Chicago, Ill., under act of March 3, 1879. Vol. XLVIII, No. 4.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FRONT LINES

THE SPINSTROMETER, described by Herman Knapp on page 93, March issue, is one of the most important temperature measuring instruments of the building heating engineer. It reminds us of another instrument, the oxometer, which has not received, we feel, the attention it deserves. The oxometer was invented several years ago by a man known only as Bill, a friend of the writer Albert Jay Nock. Mr. Nock described the device in detail in an article in one of the magazines—either Harper's or the Atlantic, we can't remember which. Ever since, we have been trying to get an oxometer but they were expensive and only a few of them were made and of course, the war stopped all work on the device. The oxometer is an apparatus whose function is to eliminate the "bull." It can be applied to a printed page, the reader looking through it by means of binocular eye-pieces. When so used, the result, according to Mr. Nock, is that the reader frequently sees nothing but large expanses of white paper. When applied to a radio broadcast receiver, the oxometer produces long periods of absolute silence, punctuated occasionally by a little music. Bill was working on a model to be worn like a head-set, for use in listening to orators, but we don't think he ever finished it.

RIGHT ALONG the line of our discussion of the need for better analysis of the technical literature in With the Editors, page 65, February 1944, we have just come across the following in the Industrial Bulletin of Arthur D. Little, Inc. "A promising project for post-war planners would be a unified indexing of the world's scientific literature. Although this literature is used solely by the scientist, it is the layman who ultimately pays millions annually for overlooked opportunities and research wasted through avoidable duplication. Few scientists realize the magnitude of the research that escapes their attention through inadequate indexing and incomplete use of available indexes." The Bulletin says a world survey some years ago indicated that some 750,000 articles of scientific interest were published each year in 15,000 periodicals. Others have estimated that only a third of the worth-while articles are indexed, for an indexing agency in a particular field can examine only a small part of the 15,000 periodicals. One solution might be establishment of an international clearing house that would assign particular periodicals to each indexing agency, which would index them all regardless of subject. This system might not involve much more effort than at present. The subject is important in view of the prospective flood of articles on developments of the present war, which scientists and engineers can use as a basis for peace-time developments.

IMPACT of the Electronic Age on age-old foundry practices will be fully felt at the Congress of the American Foundrymen's Association, to be held in Buffalo, N. Y., April 25 to 28, when the Du Mont Cyclograph will be demonstrated. This instrument accomplishes non-destructive tests and instantly checks castings for machinability, brittleness, toughness and metallic composition. It also checks both ferrous and non-ferrous metals for case depth, depth of decarburization, amount of cold working, structure, heat treatment, wall thickness, plating or cladding, etc.

SPEAKING of the Industrial Bulletin of Arthur D. Little, Inc., we hereby pass to it a large orchid—or perhaps a fragrant gardenia would be more fitting. We have been reading it regularly for years and find something new, stimulating and valuable in each issue. In the current February issue, for example, is a story about the All-American Highway, the approaching reality of Simon Bolivar's dream, and what it means culturally and economically. Then there is news about new plastic adhesives for binding metal to metal, and the use of Cycleweld. There is technical detail about new uses for the giant cement kilns built for war purposes and now being adapted to certain phases of magnesium production, sintering of iron-bearing materials and reports of a new process for simultaneously producing cast iron and Portland cement clinker in rotary kilns, used abroad. Any engineer who wants to keep himself right up in the front lines of modern developments will do well to read this Industrial Bulletin regularly. Arthur D. Little, Inc., is that famous organization of consulting chemists and engineers, with headquarters in Cambridge, Mass., that got into the newspaper feature pages some years ago by literally making a silk purse out of a sow's ear. That, however, was merely a stunt. Their work for various industries has developed many things far more startling.

CHEMICAL METHOD of preventing mud by making soil waterproof has been developed by Hercules Powder Co., and has been used in roads, airplane landing fields, and other construction projects here and abroad. By mixing Stabinol, a resin compound, with the top few inches of soil, a waterproof surface is obtained. The water will drain off or evaporate, rather than seep through the treated soil and turn it into mud. Stabinol-treated soil resists penetration of surface water, the chemical company says, and also the capillary rise of moisture from below. Its proper use means an end to muddy streets and roads, and a timesaving aid in road construction work where mud may cause delays. Stabinol can be used to stabilize unsurfaced dirt roads in rural areas where the traffic is light, or it can be mixed with soil that serves as the base on main highways with hard wearing surfaces.

AN ELECTRONIC "master mind" employing 126 vacuum tubes has been built to calibrate Signal Corps radio apparatus by Philco Corp. engineers. It saved 144,000 manhours of labor last year and, with other economies, made it possible to reduce the cost of this one type of equipment to the Government by $1,170,000 in 1943, says John Ballantyne, president of Philco Corp. Essentially the Philco calibrator consists of three parts. The first supplies a source of standard frequencies against which the Signal Corps frequency meter is calibrated. The second provides a means of mechanically and continuously driving the dial of the frequency meter and electronically generating a sharp pulse every time the frequency meter is turned through "zero beat" with the standard signal. This standard signal is derived from WWV, the United States Government standard frequency station in Washington, which in turn is calibrated against the stars. The third unit of the calibrator automatically records and tabulates the dial reading.

OIL GOES TO WAR was the theme of the 24th Annual Meeting of the American Petroleum Institute in Chicago, November 8 to 11. The discussions at this meeting were, of course, primarily technical rather than popular but for that reason were all the more authoritative. The developments carried out by the oil industry during this war have had the most profound effects, not only on the conduct of the war itself but also on the course of a number of industries outside the petroleum field. A typical example, of course, is the effect that has been produced in the power field by the diverting into the petroleum and synthetic rubber industries of a great deal of equipment such as valves, heat exchangers and air compressors that otherwise would have been used in the power engineering field. The lack of them may have increased the obsolescence in the latter. There is much more to it than that, however. All the relations between the techniques of producing, distributing and consuming petroleum and its products, coal and natural and manufactured gas, will be changed materially by present developments. Many programs of research in the coal field, such as that reported on page 118 of our October issue, are being established. Recently we have heard some talk among reputable engineers in the field of gas technology about the possibility of carrying out techniques in preparation and in distribution by pipeline that were greeted with Bronx cheers only a few years ago. If you are going to talk about planning, here is certainly a field that needs some of it. There is a growing feeling that after the war there will be widespread sentiment throughout industrial and governmental circles to start some kind of a program based on the idea of conservation of our natural resources, to treat all mineral resources as so many chemical reagents and, in the light of the available scientific knowledge of the moment, to utilize them to the best advantage, whether that utilization conforms to previous practice or not. Just how much and what kind of planning would be necessary to do this, nobody knows, but it certainly would go far beyond anything we have even thought about so far.

AIRCRAFT OUTPUT hit a new high for February —350 per day, 8,760 in all, according to C. E. Wilson, Aircraft Production Board chairman. Airframe weight hit a peak, too, four per cent above January production, 93,500,000 lb. Some 43 aircraft plants have been meeting or exceeding production schedules. Container board situation is still acute, and WPB has placed distribution of this essential packaging material under allocation control, starting April 1, 1944. Alcohol supply has improved slightly, but with the increase in production came a simultaneous increase in requirements. Recently concluded agreements with Cuba and an anticipated increase in production in the Gulf area are responsible for the improved situation. Sulphuric acid production went up, too—approximately 9,300,000 tons a year, hitting a new high. New facilities now under construction will provide additional capacity.

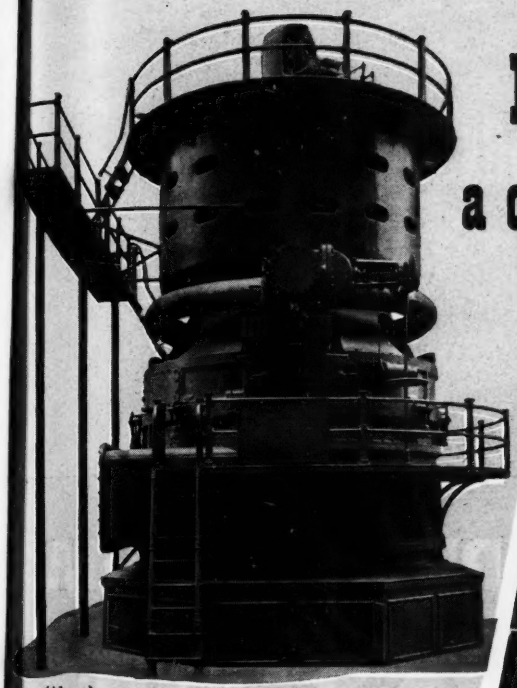
AN ENTIRELY NEW type resilient mounting utilizing rubber or rubber-like materials has been patented by Herbert H. Fink, engineer of The B. F. Goodrich Co., and assigned to the company. Mountings covered by the new invention have cylinders of rubber or rubber-like materials interconnected by arms in S-fashion. This arrangement permits an extremely soft suspension under light load and allows the resilient material freedom of movement in all directions. Handling of a variety of stresses including shear, bending, torsional or twisting is accomplished by the mounting.

DEPARTMENT OF LIBERAL EDUCATION in the House Organs in 15 Min. a Day—Make That Floor Safe; Truscon Building Maintenance, February, 1944; Truscon Laboratories * * * Fuel Saved the Digester Way, telling how Hinde & Dauch insulated digesters to save fuel; The Power Specialist, Jan.-Feb. 1944; Johns-Manville * * * The 4 Groups of Hard Facing Alloys, a very comprehensive discussion of their composition, characteristics and methods of application, with good diagrams and pictures; Fusion Facts, February 1944; Stoody Co. * * * Weapons That Win, illustrated bulletin telling the story of steel at war; American Iron & Steel Institute * * * Arctic-Tropic-Stratosphere Laboratory, illustrated story with a large detail perspective drawing of a manufactured weather laboratory; The Frick System, Feb.-March 1944; Frick Co. * * * Surface Finish, what it's really like, second article on the subject, Grits and Grinds, Vol. 34, No. 12; Norton Co. * * * New Frontiers, address at dedication of a new 100-octane plant; Standard Oil Co. (New Jersey) * * * Keeping the Gr-r-r-r-r Out of Gears; also detailed illustrated description of Watervliet Arsenal, one of a series; The Houghton Line, Feb.-March 1944; E. F. Houghton & Co. * * * Wired for War, showing with many good on-the-spot war pictures, how the Signal Corps gets the message through; also Tubing for Tomorrow—Today, showing how Tube Reducing Corp. has revolutionized an industry; also Willow Run, detailed beautifully illustrated description of the famous bomber plant and the people who make the bombers; Shell Progress, Jan.-Feb. 1944; Shell Oil Co.

TO DETECT dangerous concentrations of gases in chemical operations and manufacturing processes, the du Pont Company scientists have developed an ultra-violet photometer. Seeing a detailed description of this in the March issue of Electronic Industries, readers have asked why somebody doesn't do some work on a gadget of this type for measuring CO_2 and other constituents of combustion products. It must be remembered, however, that a CO_2 measurement must be quantitative—it must tell how much—whereas the purpose of many of the electronic devices used with gases is the detection of the presence of mere traces of a given substance. Once the trace is detected, steps must be taken to prevent further formation of the substance, and even traces of it may be injurious to workmen or products. So the reasons for the two types of measuring devices are entirely different. Perhaps something in the way of combustion measuring instruments may eventually develop from the mass spectrometer. In fact this device could be used now for this purpose but it is not only very expensive, as compared to the present types of measuring instruments, but also requires highly-trained scientists, rather than engineers, to handle it and interpret its results. It will be well to keep an eye on it, however.

IS THE STATUS of engineering education, at any given period, a cause or a result? Does it determine the course of the profession or does it merely reflect it? This writer has pondered these questions frequently, concluding often that it is an admixture of the two. But every engineer ought to pay more attention to the education of his profession at all levels—administrative, research, design, sales, operation. In its Eleventh Annual Report for the year ending September 30, 1943, the Engineer's Council for Professional Development discusses the increasing usefulness of the technical institutes, as exemplified by the ESMWT courses, and is studying this subject from the point of view of post-war technical training.

In 1903
a one-job oil was good enough...



(Above)
A granddaddy of the modern steam turbine. This 5,000 KW turbine-generator set of 1903 vintage operated at low steam temperatures and pressures . . . required no specially refined oil.

(Right)
Today's speedy, high-temperature turbines need an oil especially refined for turbine operation . . . an oil that prevents rust, and at the same time has superior oxidation stability.

BUT TODAY'S TURBINES NEED THIS 2-JOB TURBINE OIL!

1—That Prevents Rust
2—That has Superior Oxidation Stability

A GENERAL-PURPOSE lubricating oil was plenty good enough for those lumbering, old giants of yesterday.

But to withstand the severe conditions encountered in modern turbine operation, an oil must do 2 jobs at once: (1) *prevent rust*, (2) *resist oxidation*. It is this ability to do both jobs at once, to an unusual degree, that has built up for Shell Turbo Oil an enviable reputation for outstanding performance in every type of steam turbine operation.

For over a year, Shell Turbine Oil has been used aboard battleships, destroyers, aircraft carriers and other units of our fleets, under operating conditions far more severe than any met on land. In fact, Shell Turbine Oil was the first of its type to be approved as meeting rigid U. S. Navy specifications.

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ARE YARWAY VALVE E

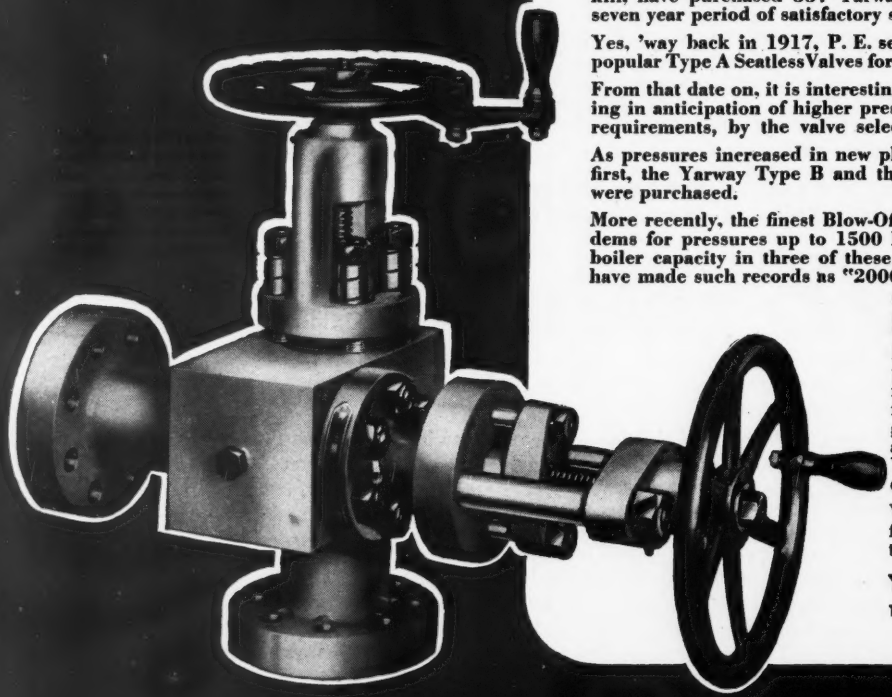
TOTALLING over 900,000 kw. these four Philadelphia Electric Company Stations—Richmond, Chester, Delaware and Schuylkill, have purchased 357 Yarway Blow-Off Valves over a twenty-seven year period of satisfactory service.

Yes, 'way back in 1917, P. E. selected their first YARWAYS—the popular Type A Seatless Valves for the then "high pressure" of 300 lb.

From that date on, it is interesting to trace Yarway's valve engineering in anticipation of higher pressures and more strenuous service requirements, by the valve selections of this outstanding utility.

As pressures increased in new plants, additions and conversions—first, the Yarway Type B and then the Type C Seatless Tandems were purchased.

More recently, the finest Blow-Off Valves of all—Yarway Unit Tandems for pressures up to 1500 lb—have been the choice for new boiler capacity in three of these plants. These are the valves that have made such records as "2000 blows at more than 1300 lb pressure without replacement of a single part or repairs of any nature." Yarway has "grown up" with many leading utilities and industrial power plants—over 12,000 of them in fact—and such records of satisfactory service in the past are your guarantee of dependable performance in the future when you select Yarway Valves for blowing down or draining and sealing service.



Write for Catalog; Section B-431 for pressures up to 2500 lb, Section B-424 for lower pressures.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.

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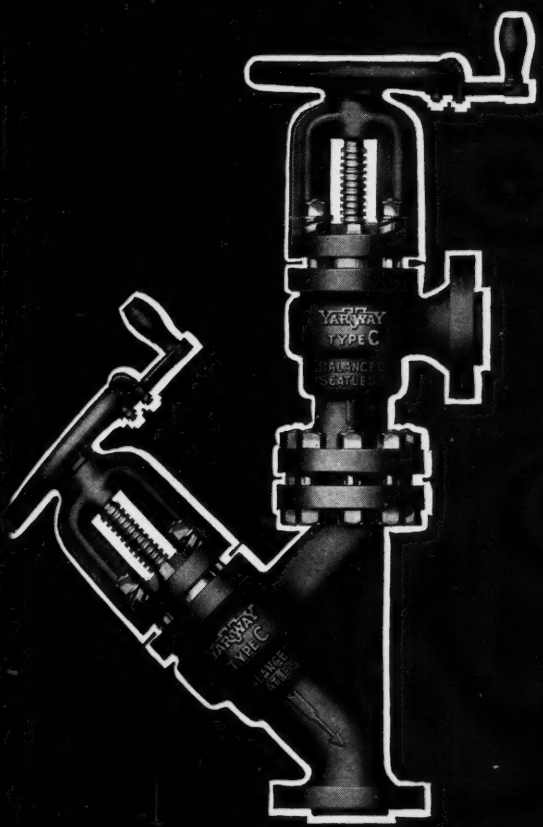
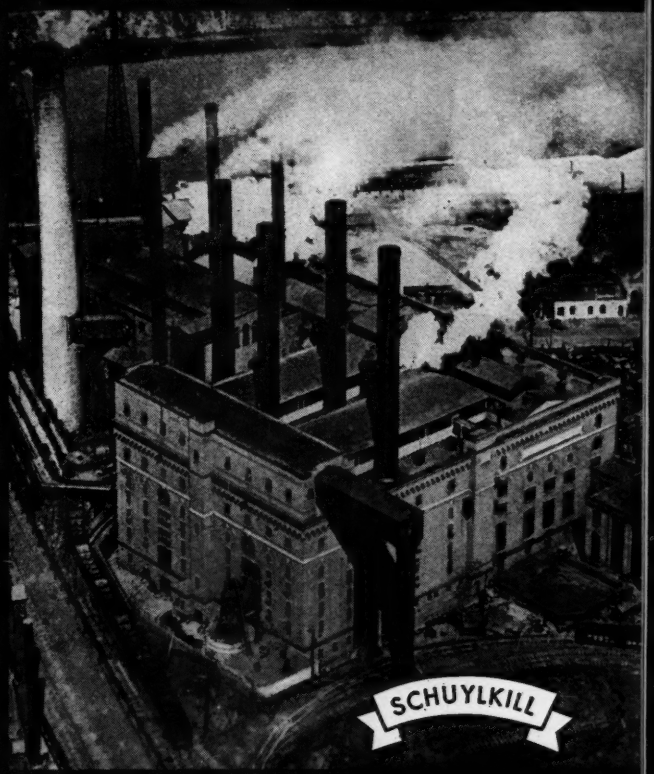
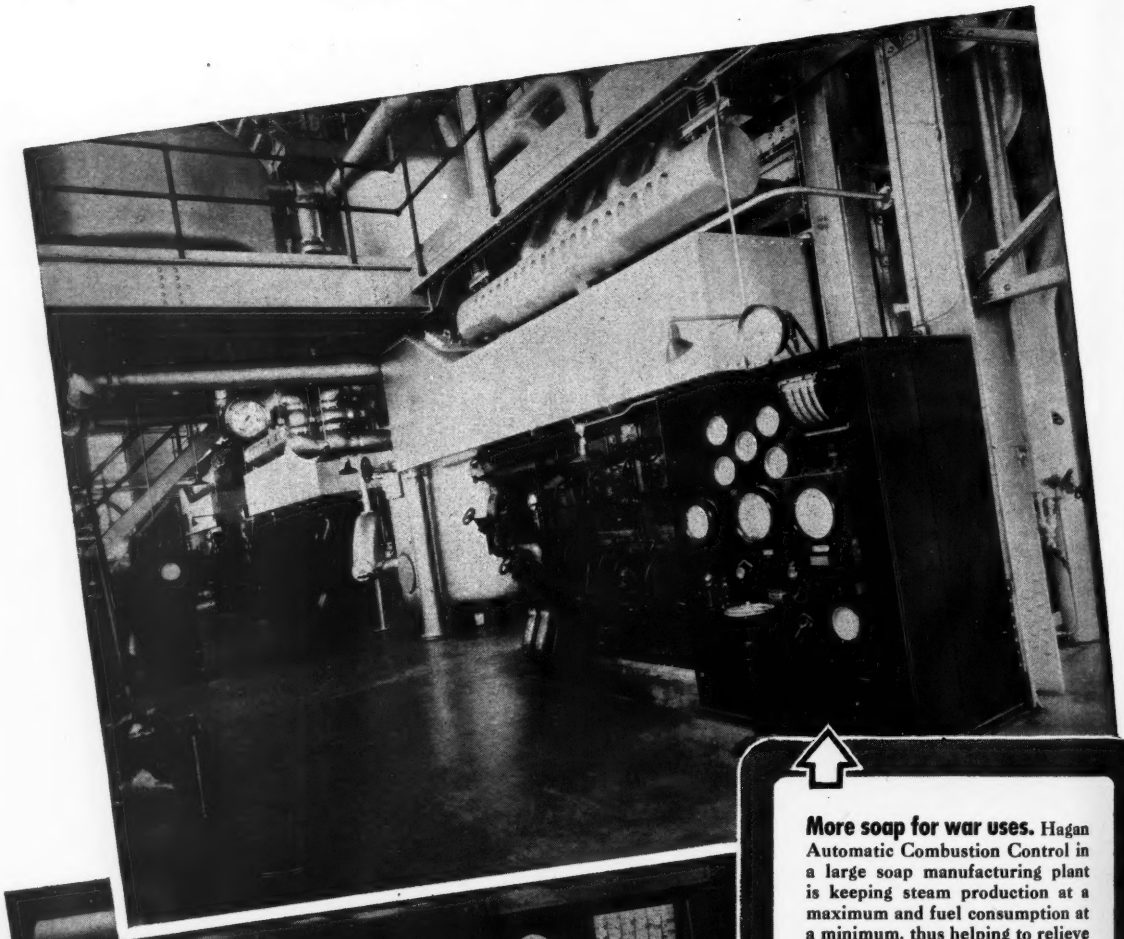




BLOW-OFF VALVES

How much would you take f



More soap for war uses. Hagan Automatic Combustion Control in a large soap manufacturing plant is keeping steam production at a maximum and fuel consumption at a minimum, thus helping to relieve scarcities of both soap and fuel.

More railroad equipment. Continuous production was necessary in the plant of this railway equipment manufacturer and Hagan Control has been maintaining peak boiler output without fail.

More aluminum. Ships transporting bauxite ore are equipped with Hagan Control which gives them equal cruising range with less fuel permitting more cargo carrying capacity.

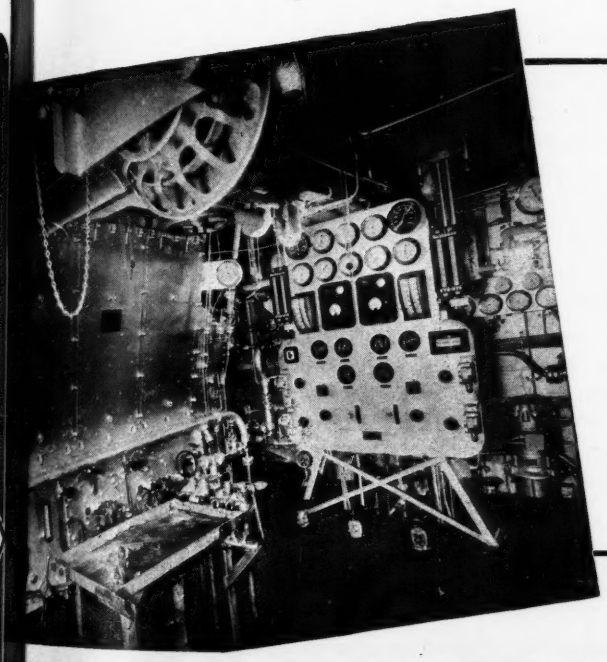
ke for your Hagan Control ?

WE might just as well ask you how much you would take for your right arm. For today, the value of automatic combustion control cannot be measured in dollars alone. Any war plant operator knows how well it has enabled him to meet the man-power problem, the fuel shortage and the demand for every possible pound of steam. He looks, also, to the long-range investment . . . the years of trouble-free service it will give.

Because of the remarkable simplicity of its operation, the sturdy way in which it is built, the exclusive Hagan features which set it in a class by itself, Hagan Control accomplishes these results with a minimum of time, attention and trouble.

If you need automatic combustion control we can help you.

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH 30, PA.



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MAXIMUM QUANTITY of steam from any given plant, by introducing fuel and air in correct proportion for utmost efficiency.

MAXIMUM UTILIZATION value, uniform steam pressure and temperature, in accordance with demand.

MAXIMUM OUTPUT from boilers of differing capacities, automatically.

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MAXIMUM PROTECTION of auxiliary equipment, fans, stokers, etc., by maintenance of uniform operating conditions.

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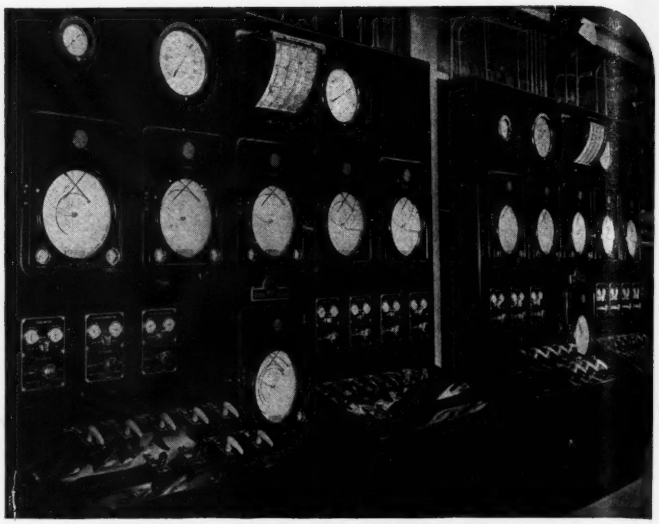
HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

ESSENTIAL IN *WAR* PROFITABLE IN *Peace*



Bailey Boiler Control Panels for two 135,000 lb. per hour capacity, oil and gas-fired boilers in a Western Power Station.

Bailey Boiler Control Conserves Fuel, Insures Safety, Increases Turbine Efficiency, Improves Continuity of Service and Simplifies Training of Operators

The same qualities of Bailey Boiler Control which make it essential in wartime power plant operation, make it profitable to use in peacetime operation.

It conserves fuel and fuel transportation facilities by automatically maintaining the correct fuel—air ratio for efficient combustion at all times.

It insures against accidents to operators and equipment by:

Accurate control of boiler water level, steam temperature and fuel—air ratio.

Interlocks to insure the proper sequence of operation.

Limiting devices to prevent operation under unstable conditions.

Alarms to warn operators of dangerous conditions such as high or low water level, flame failure, loss of air pressure, etc.

It increases turbine efficiency by supplying steam at design pressure and temperature at all times.

It improves the continuity of service by reducing furnace and boiler repairs.

It simplifies training of new operators and insures continuous economy during the training period.

These same qualities of Bailey Boiler Control which are now helping to win the war will help American industry to win the peace.

Suggestions for wartime boiler plant operation are given in our Bulletin No. 16 "How to Safely Stretch Steaming Capacity." Ask for your copy now. A-90

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Bailey Meter Company Limited, Montreal, Canada

BAILEY METER CONTROL

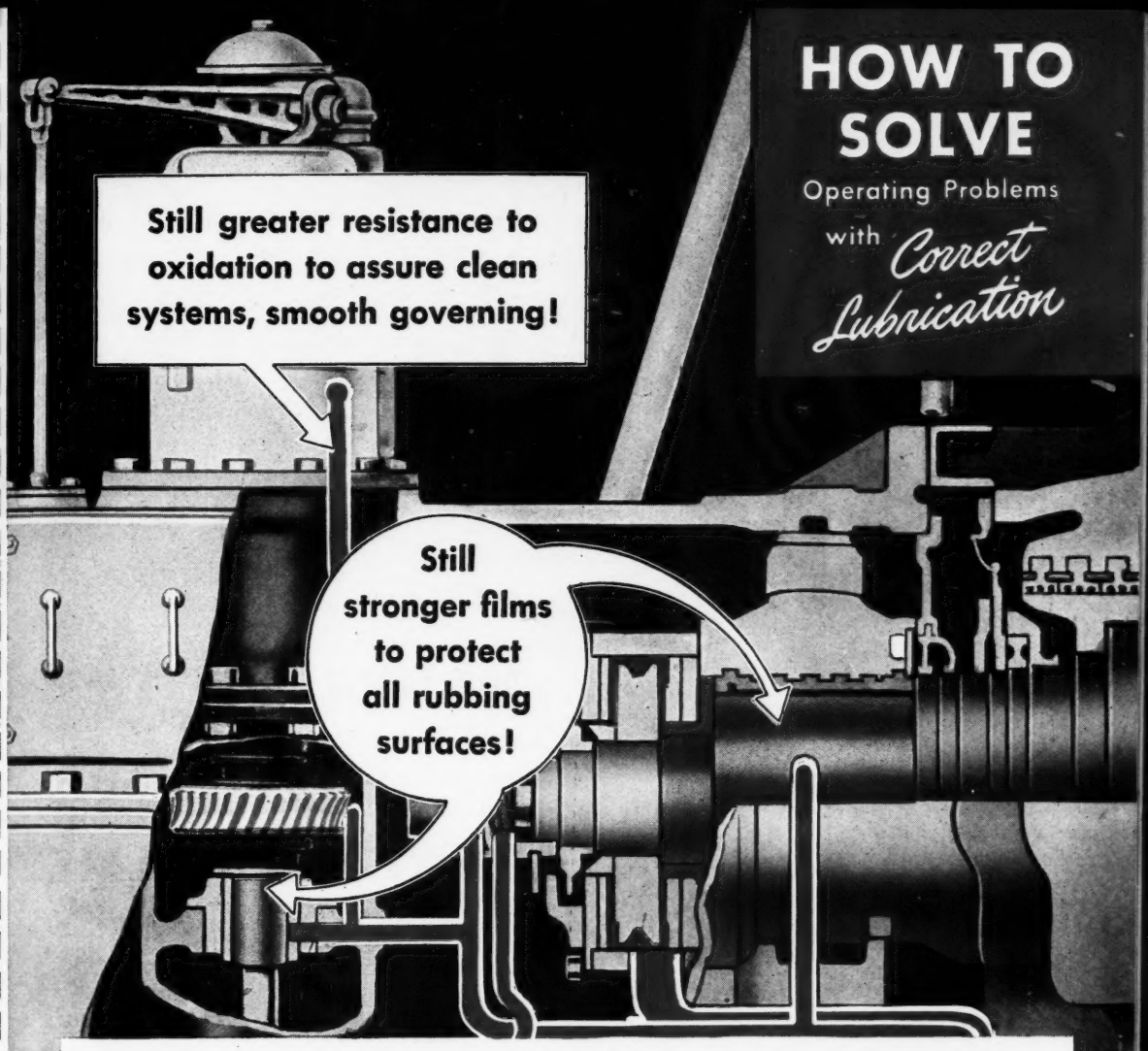
The Complete Combustion Control System

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

HOW TO SOLVE Operating Problems with *Correct Lubrication*


Still greater resistance to oxidation to assure clean systems, smooth governing!
Still stronger films to protect all rubbing surfaces!

Meet severe turbine operation with this *Extra Protection!*

UNDER today's severe operating conditions, steam turbines have become more dependent than ever upon Correct Lubrication.

The oil, serving as both a hydraulic medium for the governing system and a lubricant for swiftly moving parts, faces much higher temperatures and pressures. Yet it must stand up over years of service.

Gargoyle D.T.E. Oils for Turbines have been improved to meet the most severe conditions — to provide extra margins of protection against them. They combine greater resistance to oxidation and rust with stronger films — to set even higher standards of performance than the famous D.T.E. Oils of the past.

No wonder over 50 percent of all major-size steam turbines in the United States are lubricated by Gargoyle D.T.E. Oils.

GARGOYLE Lubricants

SOCONY-VACUUM OIL CO., INC., Standard Oil of N.Y. Div. • White Star Div. • Lubrite Div. • Chicago Div. • White Eagle Div. • Wadhams Div. • Magnolia Petroleum Company • General Petroleum Corporation of California.

GARGOYLE D.T.E. OILS

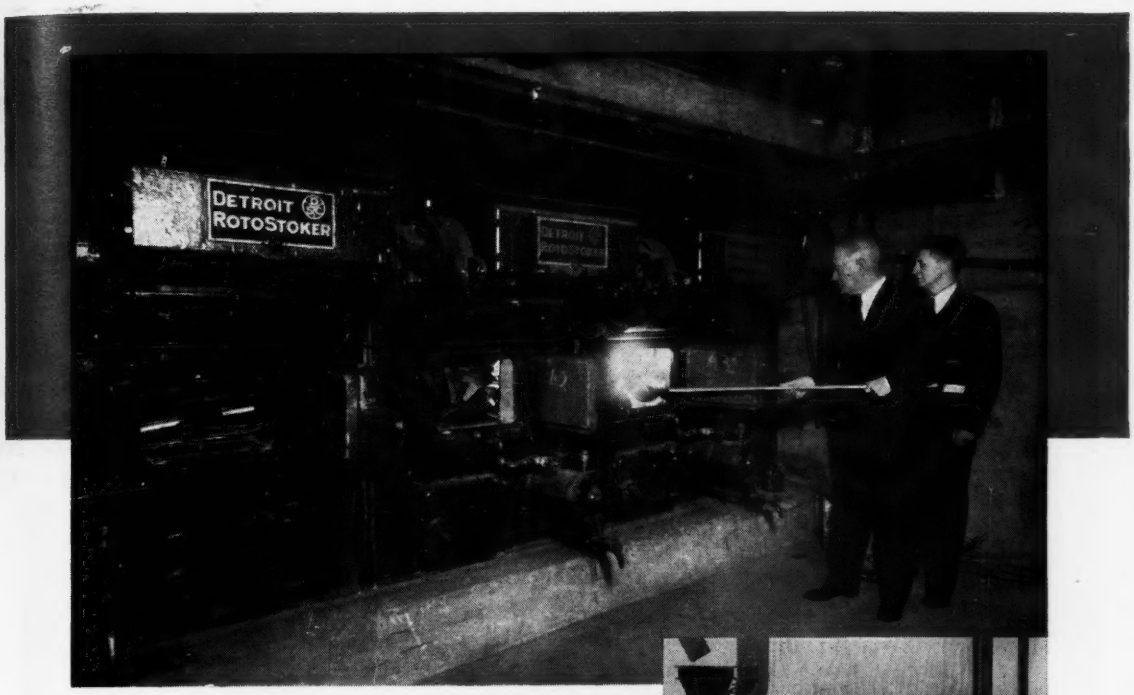
DETROIT STOKER IN McCORD PLANT

MAKERS OF THE NEW AMERICAN HELMET

McCord Radiator & Mfg. Co., who in peacetime serve Power, Automotive, Refrigeration, and Air Conditioning industries, developed quantity production methods on the famous new American Helmet—that tough, hard piece of armor that has saved lives—prevented so many wounds.

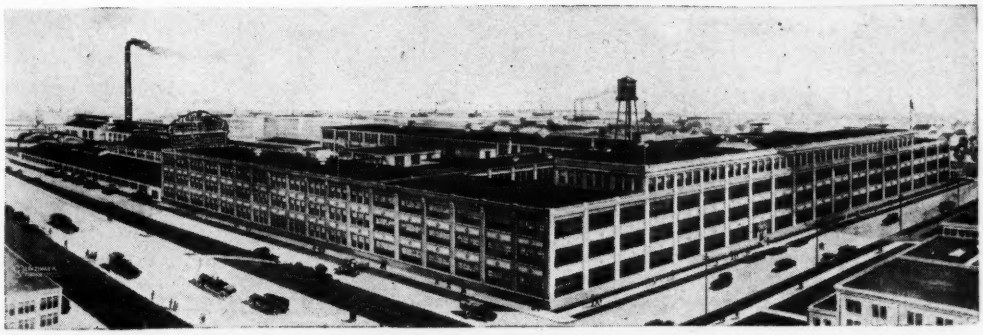
This helmet, worn by American Forces everywhere, is larger than the World War I "tin hat"—provides more protection and is more comfortable to wear.

McCord Radiator & Mfg. Co. is a long-time user of Detroit Stokers—four installations in three McCord plants.



The President of McCord Radiator & Mfg. Co. and the Works Manager starting the fire in the new Detroit RotoStoker.

Detroit RotoStoker successfully burns a wide variety of bituminous coal—handles fluctuating loads with uniform steam pressure.

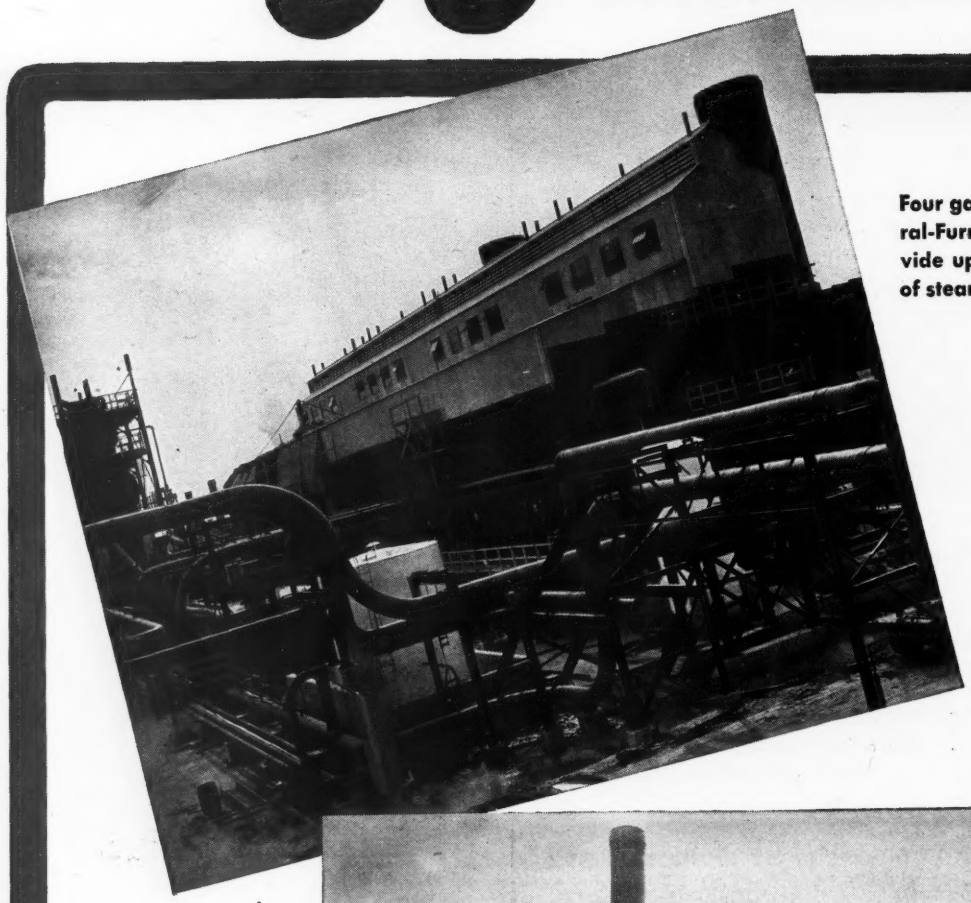


Plant No. 1 of McCord Radiator and Mfg. Co., Detroit.

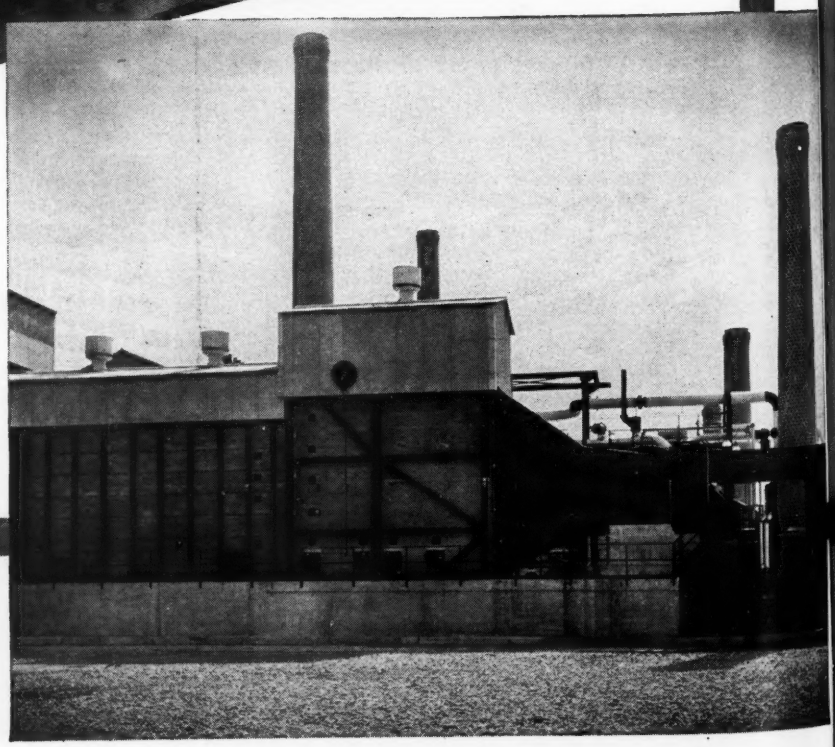
DETROIT STOKER COMPANY General Motors Bldg. Detroit, Michigan

Works at Monroe, Michigan • District Offices in Principal Cities • Built in Canada at London, Ontario

50 MILLION P



Four gas-fired B&W Integ
ral-Furnace Boilers pro
vide up to 50,000,000 lb.
of steam a day at 450 psi.



About half the steam from the boilers is re-heated to 1250° F. in six B&W gas-fired superheaters.

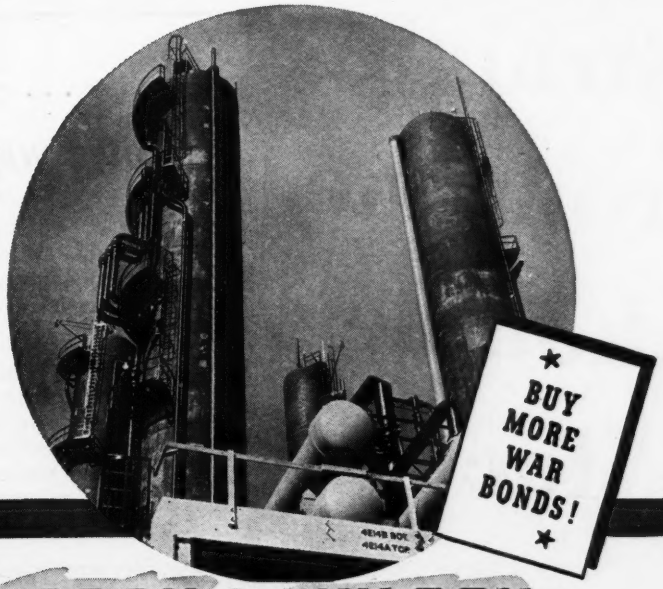
Photographs courtesy of The Lummus Company

POUNDS OF STEAM *to* BOOST BUTADIENE *Production*

The butadiene plant at Port Neches, one of the world's larger plants, is designed to produce 100,000 tons of butadiene annually—enough for one-seventh of the government's war-time program for vital synthetic rubber production. This plant provides a strange new skyline for this part of Texas, with steel fractionating towers rearing their tops as high as a 17-story building.

The 50,000,000 pounds of steam required daily for high-temperature heating processes, low-temperature boiling, and for power drives will be provided by 4 B&W Integral-Furnace boilers of central-station size. About half the steam from the boilers is re-heated in specially designed separately-fired superheaters of B&W manufacture, in which the temperature is raised to the high degree necessary for dehydrogenation of butylene, the most difficult step in the process.

To the originators of this important project and to The Lummus Company, designers and builders of the plant, go the sincere congratulations of this Company for the spirit in which it was undertaken, organized, and carried out. We are proud that we were called upon to contribute to the project from our experience with high-temperature steam problems and fabrication of welded pressure vessels.



Sky-scraping fractionating towers were fabricated on the site from steel plate under B&W supervision in a specially constructed shop, the design and erection of which were supervised by B&W engineers.

G-269 T

BABCOCK & WILCOX

THE BABCOCK & WILCOX COMPANY

85 LIBERTY STREET • NEW YORK 6, N. Y.

Stopping boiler troubles before they become critical. Hall Laboratories' careful, periodic analysis of boiler water from your plant, coupled with simplified control analyses by the plant personnel, uncovers boiler troubles before they become serious, permits preventive treatment which keeps plants in continuous operation.

Straight from the shoulder facts

• • • ON SCIENTIFIC BOILER WATER CONDITIONING

PROBABLY every power plant engineer who reads this not only believes in preventive care as protection against boiler failures, but to the best of his knowledge practices it.

There can be only one reason, therefore, for the endless recurrence of problems arising from scale, corrosion, carryover and embrittlement. The measures he can and does take don't go far enough. The science of boiler water conditioning and the

HALL SYSTEM

Latest X-ray Equipment shows up constituents in complex boiler deposits which may be missed by other forms of analysis. This is an extra assurance you have that Hall Treatment will be correct.

Hall Service in a Nutshell

At your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

1. Minimizes boiler outages caused by water.
2. Helps maintain highest efficiency.
3. Establishes non-embrittling water.
4. Minimizes carryover.
5. Prevents corrosion in boilers and associated equipment.
6. Prevents deposition in water lines and cooling systems.

For controlling silica scale and corrosion in high-pressure boilers

The new Hall P-T-X System, based on a potassium equilibrium instead of sodium, is showing remarkable results in eliminating troubles in high-pressure boilers which had previously defied solution.

remedying of trouble-making conditions call for the specialized supervision of the experienced physical chemist. Few engineers have either the preparation or time to meet this additional requirement.

That explains why even the most modernly equipped and competently staffed power plants rely on the cooperative assistance of Hall Laboratories.

Hall preventive care is an original and exclusively Hall development, the product of twenty years' experience in keeping the nation's boilers on the line. It cannot be duplicated because no other service in the world can offer its scientific background, substitute for its Hall-trained field personnel, or even approach its many contributions to industrial water treatment.

And, now to this record has been added a new accomplishment—the Hall P-T-X System—which provides the *first* actual solution for many problems originating in the steam-water interfaces of the boiler system, particularly metal corrosion and siliceous scales.

Why not let us explain more fully how Hall service in preventive care will enable you to share in this knowledge and experience?

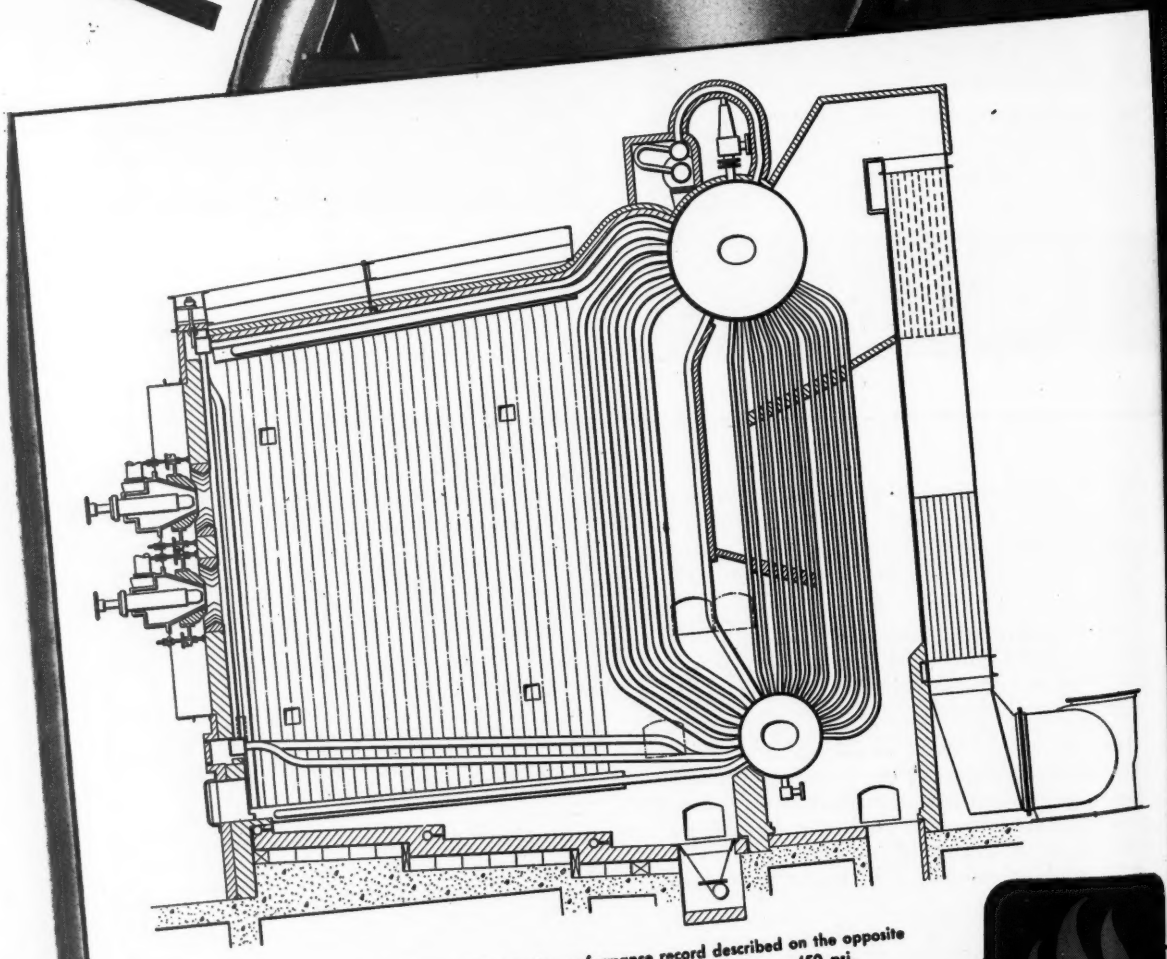
HALL LABORATORIES, INC., Hagan Building, Pittsburgh 30, Pa.

Subsidiary of Hagan Corporation

of Boiler Water Conditioning

HAGAN
HALL
BUROMIN
CALGON

AROUND THE CLOCK



This is the unit responsible for the performance record described on the opposite page. Capacity — 43,000 lb of steam per hr. Design pressure — 450 psi.

C-E

7 days a week

...and *never* a forced outage

About five years ago an eastern paper board company, confronted with the necessity of replacing over age, inefficient boiler equipment, installed a C-E Steam Generator, Type VU. The plant's maximum steam requirement, at the time, was about 43,000 pounds per hour, and this unit was guaranteed to supply it. Pulverized fuel firing was selected using a C-E Raymond Bowl Mill and two C-E Horizontal Burners equipped to burn oil as an alternate fuel if desired.

The purchaser had planned to use the old equipment for standby service, but almost from the time of its initial operation the C-E Unit took over the entire plant load. "Took it over" so completely and reliably that within a year the other equipment was abandoned.

Then wartime demands stepped up the plant output to the now familiar 24 hours a day — 7 days a week basis. Steam needs rose accordingly. How well this C-E Unit responded is evident from the following statement of a company official.

"This unit does all that we ask of it — always. It works around the clock — 7 days a week for months on end until we shut down the entire plant for scheduled inspection and maintenance of all equipment. We need an average of between 50,000 and 60,000 lb of steam per hour and we're getting it — with never a forced outage."

Thus the extra values — the reserve — in C-E design and construction are demonstrated again. The same type of performance repeated in many different *war* plants has established the ability of C-E equipment to meet every demand with consistent dependability. You can assure this quality of performance for your *peace-time* steam needs — Specify C-E. A-777

COMBUSTION ENGINEERING

200 MADISON AVENUE, NEW YORK 16, N.Y.

Progress and Power in

PUBLIC UTILITIES

The Wheel of an American Blower Sirocco Induced Draft Fan. Fans of this type are functioning in many of the nation's largest power plants and in industry.

Unprecedented demand for vital electric energy placed upon the public utilities of America greatest load in their history. Working day a night to the limit of their capacity, they are p viding continuously over 50,000,000 kilowatts dependable electric power to the industries, mi tary centers, transit lines and homes of the nati

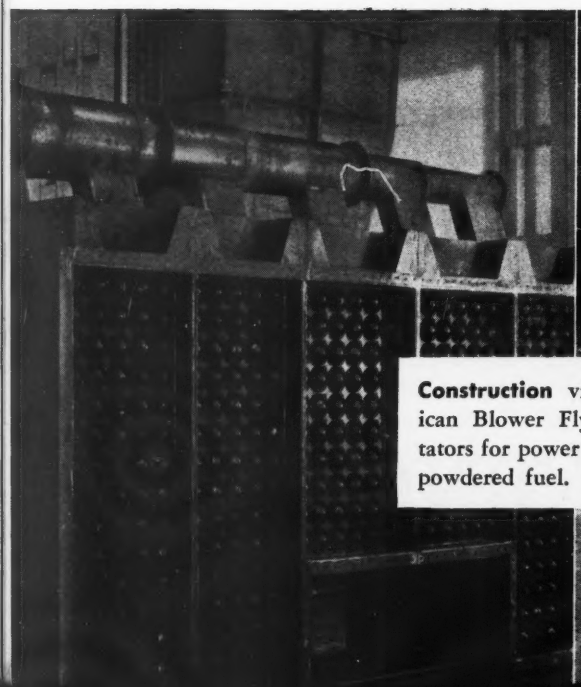
Working shoulder to shoulder with the pub utilities to provide this mighty output is mode equipment developed and built by Americ Blower — forced and induced draft fans, blowe fly ash precipitators and fluid drives (hydrau couplings) for variable speed control of fans a pumps.

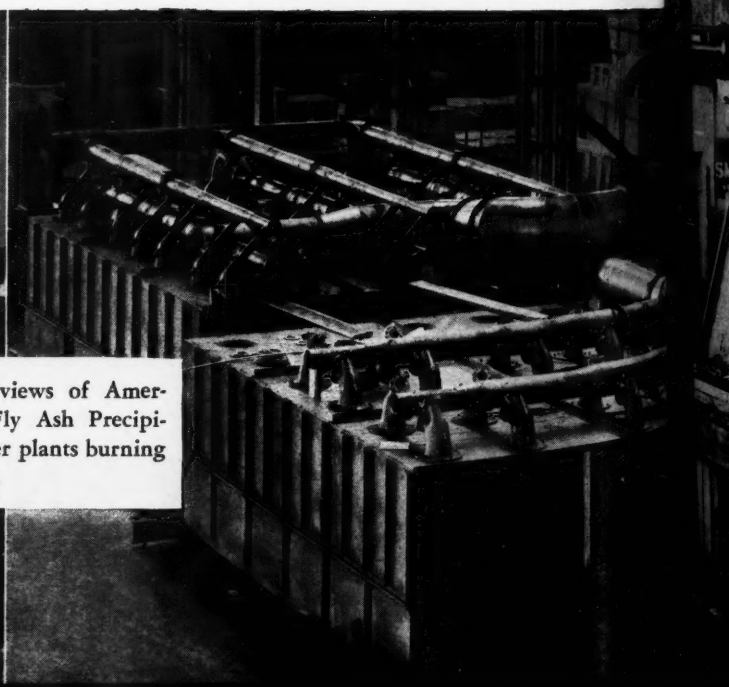
When new installations or replacements power plants are contemplated, consult American Blower, makers of mechanical draft and other equipment for air handling since 1881.

ARMY E NAVY
For Production "Well Done"

AMERICAN BLOWE

AMERICAN BLOWER CORPORATION, DETROIT, MICH
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT
Division of American Radiator & Standard Sanitary





Construction views of American Blower Fly Ash Precipitators for power plants burning powdered fuel.

Two views of 2400 brake horsepower American Blower Sirocco Induced Draft Fan built to provide a boiler draft of 25" water gauge at 380 degrees Fahrenheit.

Scovill Tube News

Vol. 2 SCOVILL MANUFACTURING COMPANY, Waterbury 91, Conn. No. 3

Condenser Tube Installation Methods and Their Influence on Tube Life

Scovill engineers discuss the proper controls to prevent the most common troubles

The importance of proper tube installation in tubular heat exchangers has been repeatedly demonstrated both for new equipment and for retubing. Tube life and tube sheet life frequently have been shortened by the lack of proper control over the installation method. Distorted and cracked tube sheets; corroded, split, and cracked tubes — all have resulted from excessive or improper rolling or joint design.

As the importance of installation methods has become generally recognized, various controls have been developed to prevent excessive rolling — the most commonly encountered fault: —

1. Tubular "stops" are placed on the expander mandrel behind the carriage to prevent mandrel entrance beyond the desired point.
2. Limited pneumatic pressure is used for the operation of expander air motors.
3. Expanders are available fitted with cylindrical rolls, and with mandrels tapered in front and cylindrical at back. Tapered section of mandrel expands tube the desired amount, after which rolls slide over into cylindrical section of the mandrel and do no further work.

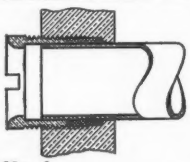
These and other methods are successfully used for *control* which is one of the primary requirements.

Scovill's tube engineers always have recognized the importance of proper installation on tube and unit life and have pioneered many of the improved tools and methods.

Since the tubular "stop" on the expander mandrel — as a means for controlling expansion — is simple, positive, applicable to all standard expanders, and calls for no specialized equipment, it has been used and widely recommended by us.

The following eight illustrations show methods of installation, and give a brief explanation of the advantages or disadvantages of each. More complete information is contained in "Scovill Condenser Tubes", a new edition of which will shortly be available.

Detail data given is authoritative for nonferrous tubes of common condenser tube sizes only (⅝" to 1¼" O.D. and 14 (.083") to 18 (.049") Ga.), but many of the details and practically all of the principles can and should be applied to other sizes and materials.

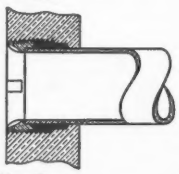


Method No. 1

Formerly the usual method of installing tubes in marine and stationary steam condensers. Inferior because of:

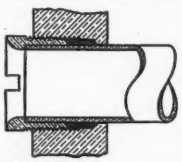
A. Protrusion into water box to create turbulence.

B. Pocket between inside shoulder of ferrule and tube end.



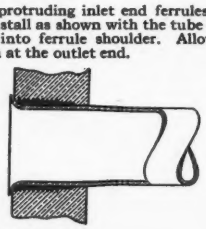
Method No. 3

This "flush-type ferrule"* can be installed as easily as the regular projecting type, but with this method, no inlet end air pocket is formed; and as there are no projections into the water box, turbulence is kept to a minimum.



Method No. 2

Where protruding inlet end ferrules must be used, install as shown with the tube end fitted snugly into ferrule shoulder. Allow for expansion at the outlet end.



Method No. 4

Recommended for renewing old tube sheets originally using ferrules. For this method a special bushing is inserted to replace the ferrule. The bushing is then reamed, radius cut, and grooved, after which the tube is expanded, flared, and beaded into position. See notes I, II, IV, V, VIII.

**Patented*

NOTES

I — Air entrained in the circulating water, or released from solution by turbulence or low pressure areas, frequently has a destructive effect on tubes. Streamlining of tube inlet ends reduces turbulence and minimizes the release of air from solution. This is of vital importance in steam condensers.

In oil refinery heat exchanger units, often operated under pressure, velocities are commonly so low, and impingement attack so uncommon, that tubes are satisfactorily installed by expanding without flaring or beading.

II — Reamed hole tolerances should not exceed plus and minus .002".

III — Locating inlet end of tube and avoidance of creep during expansion — any one of several methods may be used.

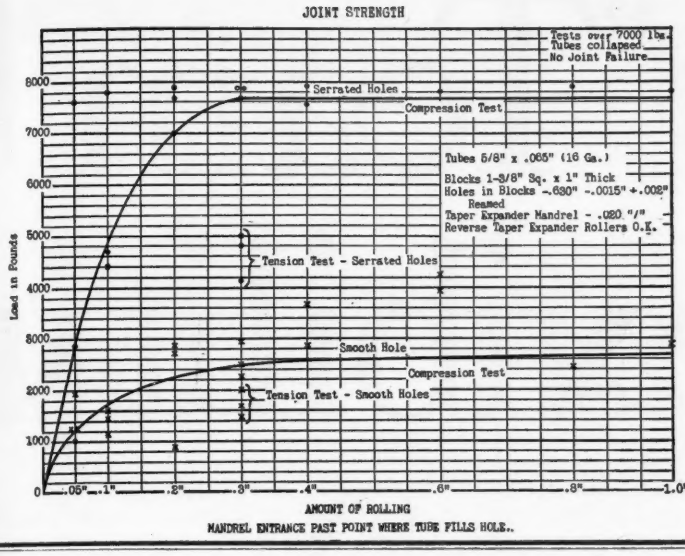
A. Scovill screw-in holding tool at outlet end, or Scovill combination tube puller and holder.

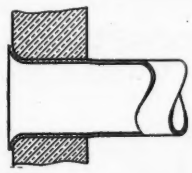
B. The outlet end, if to be expanded, may be rolled first, and the tube faced to length at the inlet end.

C. Expanders supplied by Scovill are recessed to receive the tube end and arranged to set the tube in the proper position where its location may be noted and held by a workman at the outlet end.

IV — Expanded length should extend through the tube sheet to prevent space between sheet and tube in which corrosive shell side media might collect, stagnate, and initiate active corrosion.

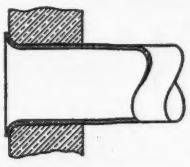
V — Expanded length should not extend beyond inner face of tube sheet, otherwise, an unsupported expanded section subject to stress corrosion or fatigue cracking will be created.





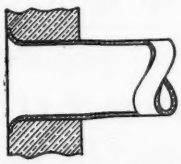
Method No. 5

Expanded to metal vs. metal joint with tube sheet. Tube sheet must be drilled, reamed, radius cut, after which the tube is expanded, flared, and beaded. This method is superior to methods No. 1 and No. 2. See notes I, II, III, IV, V.



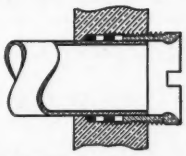
Method No. 6

In this method, the tube is expanded into a serrated hole which provides superior joint strength and permanence without excessive expansion. Tube sheet must be drilled, reamed, radius cut, grooved, after which the tube is expanded, flared, and beaded. See notes I, II, III, IV, V, VII, VIII.



Method No. 7

This is a refinement of method No. 6, but in method No. 7 the tube sheet has been recessed so that the beaded tube is flush with the tube sheet surface. This method requires that the tube sheet be drilled, reamed, radius cut, recessed, hole grooved, after which the tube is expanded, faced off to exact length if required, flared, and beaded. See notes I, II, III, IV, V, VII, VIII.



Method No. 8

This illustrates the use of Scovill's improved streamline ferrule for outlet end joints. It provides ample room for tube expansion, but the streamlined shoulder prevents the tube from dropping free of the inlet tube sheet. Although not illustrated, satisfactory outlet end joints can also be made without ferrules by the use of alternate rings of soft metal and fibre in the proper proportions.

VI — A short bevel or radius at inner face of tube sheet holes is recommended to minimize the potentially damaging effect of sharp edges against which vibration may occur and stresses concentrate.

VII — Allowance should be made for expansion and contraction of tubes due to thermal differentials in service. Various methods are used successfully.

A. Expansion joints in shell.

B. Floating heads (commonly used in small exchangers).

C. Bowed tubes — bow should be upward in order that tubes will drain when idle. This is frequently of great importance.

D. Tubes tight and fixed at inlet ends — pressure tight but free to slip at outlet ends (as with alternate rings of soft metal and fibre in proper proportions).

E. Tubes rolled at one end, then heated slightly over operating temperature and rolled at other end while hot. Tubes are then under slight tension when cold, but of proper length, and without stress while operating. The stress while idle has never, within Scovill's experience, caused trouble.

VIII — Serrated vs. smooth tube sheet holes. The advantage in joint strength obtained through the use of serrated tube sheet holes is clearly demonstrated in the chart in upper left corner.

TWO OTHER SCOVILL SERVICES —

The information in this article is illustrative of Scovill *Service in Manuals.* Other Scovill services welcomed by heat exchanger operators are *Service in Metals* — which means the facilities of our laboratories (as national needs permit) to help determine the best alloy for your conditions . . . and *Service in Men* — which means close cooperation from Scovill engineers in planning proper installation and in investigation where necessary.

For Scovill's new manual, advice on metals, or personal service of a Scovill engineer, address Scovill Manufacturing Co., 17 Mill St., Waterbury 91, Conn.

THIS IS NUMBER NINE in a Series of Scovill Advertisements to help you get longer life from condenser and heat exchanger tubes.

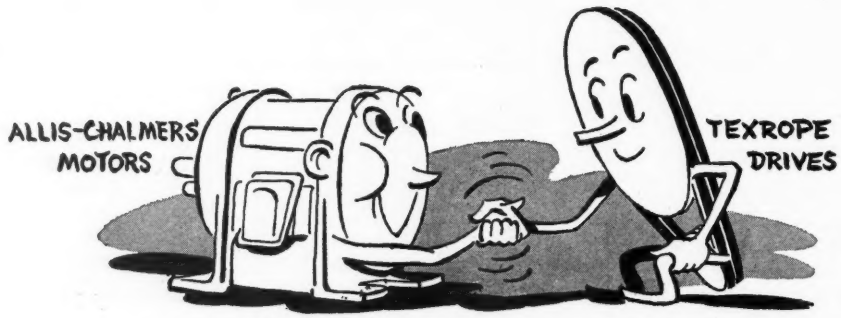
Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

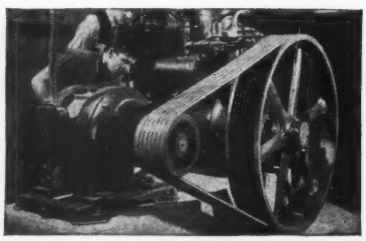
ONE PRODUCT . . . THREE SERVICES

Service in Manuals . . . Service in Metals . . . Service in Men

A-C "Team" Flexibility

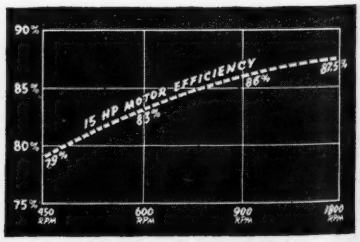


★ To drive low speed machinery with high speed motors (now that low speed motors are sharply restricted), Allis-Chalmers Texrope Drives can "gear down" motor speeds over a range of 7 to 1. As America's only builder of *both* motors and V-belt drives, Allis-Chalmers has long studied and advocated their use in proper com-



1 In most applications, an 1800 rpm motor with Texrope Drive will ably do the job of a lower-speed, direct-connected motor —at lower cost in money *and materials!*

2 When you buy an 1800 rpm instead of 450 rpm 15 hp squirrel-cage motor, for example, 600 lb are saved. And *you* save well over $200 — with drive figured in!



3 Note that efficiency rises from 79% for the 450 rpm motor to 87.5% for the 1800 rpm motor. The 1800 rpm motor saves you over 30 kw/24 hr. day.

A-C ALLIS-CHALMERS MILWAUKEE
WE WORK FOR VICTORY
WE PLAN FOR PEACE

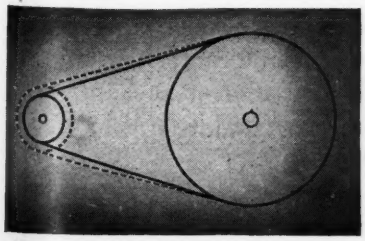
ALLIS-

Gives You now needed

bination . . . today offers you the benefit of long pioneering experience. Texrope Drives are compact, highly efficient, protect your equipment by absorbing shock.

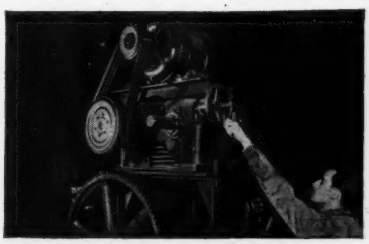
★ To drive a machine at different rates with a single speed motor (now that multi-speed motors are sharply restricted), Texrope Adjustable-Speed Drives give you infinite speed range up to 375%. And in Allis-Chalmers full line of Texrope Drive equipment you'll find the *right* range for your machines . . . thus avoid paying extra for more speed than you need. For engineering cooperation, feel free to call on your nearby Allis-Chalmers district office or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

A 1706



4 Infrequently needed speed changes can be had by changing from one size motor sheave to another. Juggling *complete* drives, range is 1:1 to 7:1.

5 With the Allis-Chalmers Vari-Pitch Sheave, you can increase or decrease speed by adjusting sheave diameter . . . obtaining an *unbroken* series of speeds!

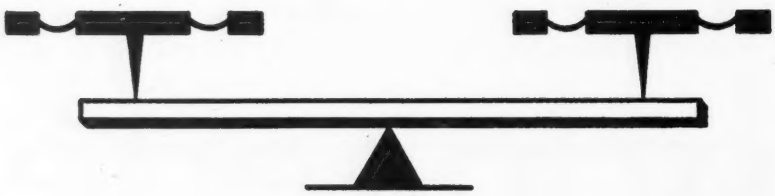


6 Allis-Chalmers Vari-Pitch Speed Changer gives you infinite changes at the turn of a wheel — within 3.75 to 1. It's compact, flexible, *efficient!*

A-CHALMERS

LO-MAINTENANCE MOTORS
TEXROPE DRIVES

ACTION AND REACTION MUST BE EQUAL AND OPPOSITE



FORCE BALANCE

PRINCIPLE OF MEASUREMENT AND CONTROL

New standards of sensitivity and accuracy are being established in the measurement and control of flow—pressure—liquid level and temperature by recent developments in the application of the Force Balance principle to automatic metering and control equipment.

A Force Balance, as the name implies, is where the force of the function being measured is opposed by a like or proportional force. Where this principle is employed a negligible movement of the measuring element gives full scale reading. This basic characteristic of the Force Balance principle is of prime importance because—

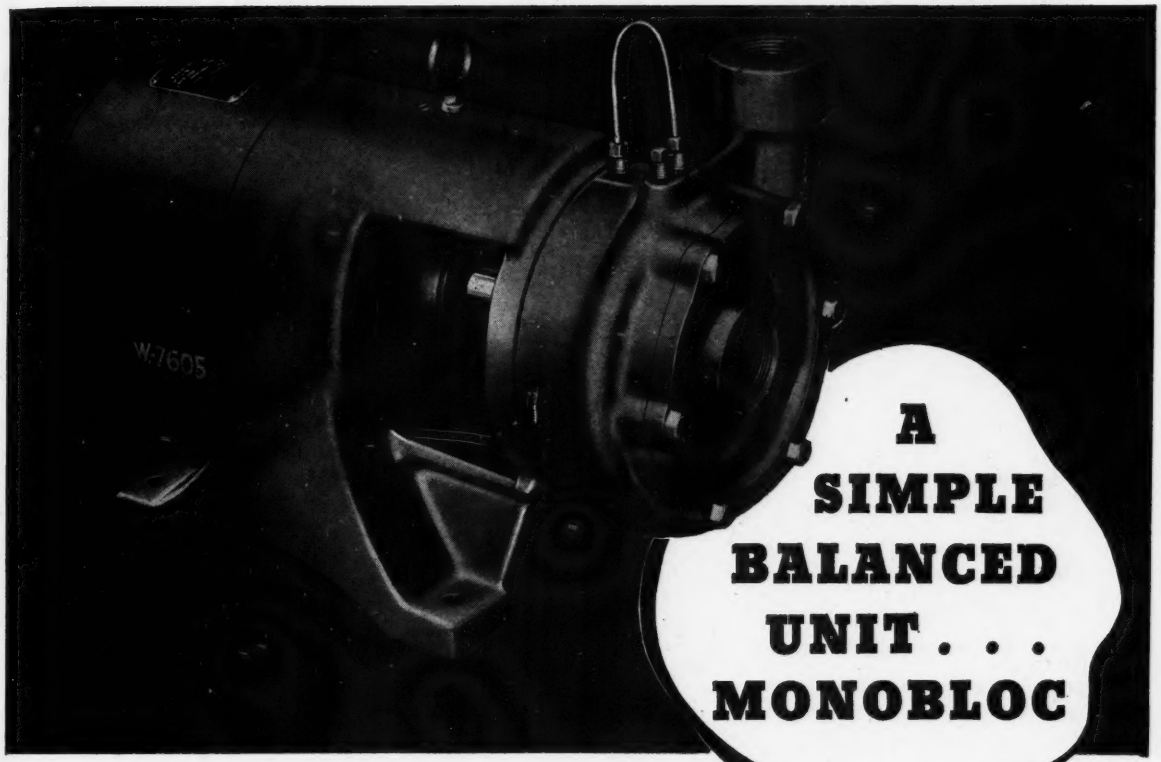
IT ELIMINATES — frictional errors
— elastic hysteresis
— volume displacement
— detectable dead spot

IT PERMITS — extreme accuracy
— super sensitivity
— instant response
— wide application

The Smoot Engineering Corp., now a part of the Republic Flow Meters Co., were early pioneers in the application of the Force Balance principle to automatic metering and control equipment. The first Smoot regulators built in 1914 incorporated the Force Balance principle as have all Smoot (now Republic) regulators since that time.

Republic engineers will be glad to co-operate with you in the solution of any metering or control problem you may have. Write us today.

REPUBLIC FLOW METERS CO., 2224 Diversey Parkway, Chicago 47, Illinois



A SIMPLE BALANCED UNIT . . . MONOBLOC

. . . NOT just a pump and conventional motor

AN HYDRAULICALLY-BALANCED Worthington centrifugal pump plus a moisture-resisting, drip-proof motor designed exactly for the pump's precise job — that's the Worthington MONOBLOC.

That's what you see at a glance. Further inspection reveals that the pump's impeller is hand-finished, perfectly balanced and rigidly keyed to a large-diameter, short-length shaft. Another look shows plenty of room for gland inspection and adjustment. Then you notice the extra-high motor support as a precaution against floor flooding . . . and no need for a base plate. And when you finally observe the extra-large shielded grease retaining bearings for lengthening the unit's life . . . you must admit that every effort has been made to give you the most work for the least power expenditure.

For water supply, boiler feed, circulation, process waste, etc. — save space, power, time and money with MONOBLOC. Write today for Bulletin W-321-B14. And if you ever need the benefit of experience won from 15 years of MONOBLOC manufacture, contact an authorized Worthington dealer or our District office nearest you.

WORTH BEHIND THE NAME WORTHINGTON

CP4-4

A 30 SECOND REVIEW OF MONOBLOC FEATURES

1. Balanced for extra strength and rigidity.
2. Impeller is hand-finished and keyed to shaft.
3. Motor is moisture-resistant and drip-proof.
4. Motor support elevated to avoid floor-flooding.
5. Ample room for gland inspection and adjustment.
6. One-piece shaft has large diameter . . . keeps moving parts true.
7. Shielded bearings are extra large for extra life.

MONOBLOC

a complete line from 1/4 to 60 H.P.

Part of Worthington's Standard Industrial Equipment Line For Re-Sale — including

Centrifugal Pumps
Steam Pumps
Rotary Pumps
Power Pumps
Vertical and Horizontal Compressors
Industrial Meters
Multi-V-Drives with Q. D. Sheaves
Worthington Allspeed Drives

Standard Products Division

WORTHINGTON PUMP AND MACHINERY CORPORATION, HARRISON, N. J.

Testing is Your Protection

90,000 cu. ft. per min. turbine-driven blast furnace blower on test in De Laval Works

The De Laval Testing Division, which is operated as a separate department by competent men who devote their entire time to testing, is of benefit to purchasers of De Laval equipment in two ways:

1. Testing gives assurance that the apparatus meets guarantees as to efficiency, head or pressure, volume or capacity, etc., and that its mechanical operation is satisfactory.

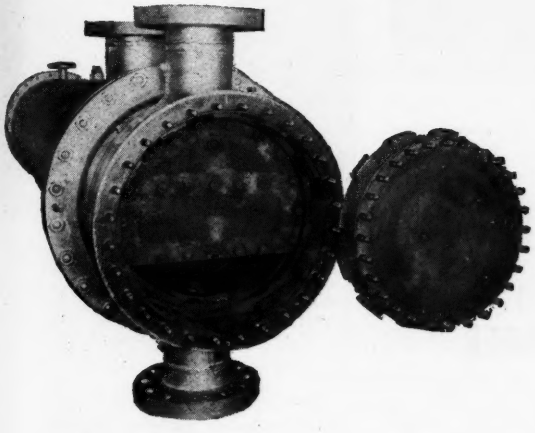
2. The results of tests on each machine enable the De Laval designing engineers to improve and perfect the product.

Where apparatus must be built for a great variety of operating conditions, as in the case of steam turbines, centrifugal pumps and compressors and rotary pumps, a consistent policy of testing is particularly important.

M-26

DE LAVAL *Steam Turbine Co.* TRENTON 2, N.J.

MANUFACTURERS OF TURBINES . . . STEAM, HYDRAULIC; PUMPS . . . CENTRIFUGAL, CLOGLESS, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, PROPELLER; PRIMING SYSTEMS; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS . . . WORM, HELICAL; and FLEXIBLE COUPLINGS



The pressure-sealing member and head cover gasket of the G-R Type "L" Stage or Extraction Heater are located OUTSIDE of the cover.

Therefore, any seepage which might occur at this gasketed joint is immediately visible, and can be remedied easily without removing the water head cover.

This G-R Heater has many additional important advantages . . . elimination of heavy bolts to maintain tightness of head-cover joints . . . ready removal of water head cover . . . partition pass plates which prevent inter-pass leakage without requiring stay bolts . . . enveloping steam baffle which permits cross-over temperatures of water and steam. These and other features are described in Bulletin 277 which will be sent on request.

THE GRISCOM-RUSSELL CO. • 285 MADISON AVENUE, NEW YORK 17, N.Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

Refrigeration-plant operator reads Micromax Temperature-Difference Recorder in plant of Atlantic Refining Co.

depends on me!
A Slogan For Every American

ANOTHER STEP-UP IN REFRIGERATION EFFICIENCY

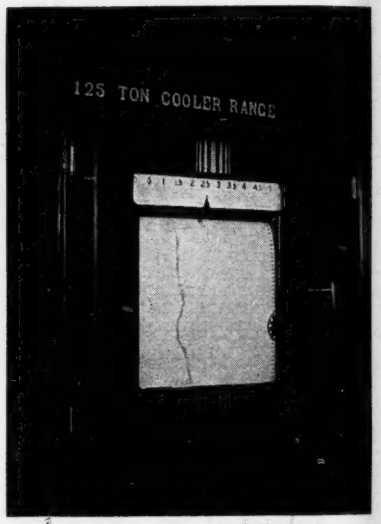
CAN FOLLOW USE OF MICROMAX SHORT-RANGE TEMPERATURE-DIFFERENCE RECORDER

Refrigeration production is of course expected to be efficient at the Atlantic Refining Co.; its engineers and operators have for years kept their eyes on the heat balance, and have applied dozens of ideas, machines and services which increase the efficiency of refrigeration-machine operation. The regular use, by this company, of the short-range Micromax Temperature-Difference Recorders seems, therefore, to indicate that this instrument has widespread value in many plants, for closer control of commercial-refrigeration operations.

The features of this Recorder which make it particularly valuable in this service are its short range (as little as 0-5 F) and its micro-responsiveness.

The equipment employs our standard Thermohm resistance-thermometer bulbs as temperature detectors. These are especially designed to make full use of the remarkably high sensitivity which may be attained with resistors. Also, these units are matched in resistance for the low temperature and for the five-degree range—conditions which require considerable skill and experience to overcome, but which are no longer problems to the Micromax equipment.

One of these specially-matched Thermohms is in the brine inlet, and the other in the outlet of the cooler. The Micromax Recorder measures the difference between them with a micro-responsiveness so great that some of its motion may be hard to see. But the effect shows in the record; the five degrees of temperature difference are spread across a chart almost ten inches wide, so that each degree has almost two inches. This extremely detailed showing of the temperature difference on which efficiency largely depends, helps the refrigeration-machine operator to anticipate temperature changes — head them off while they're still only beginning—hold temperature with the steadiness essential to highly efficient refrigeration.



Close-up of Micromax Temperature-Difference Recorder. Range is only 0-5F; note open easy-to-read record curve. This instrument operates directly from 115-volt line; no dry cell is employed; thus its sensitivity is not impaired by voltage changes.

This Micromax and all other models are described in Catalog N-33C, sent on request. If you have a specific problem in refrigeration, however, we suggest that you outline it so that additional specific facts can be submitted.

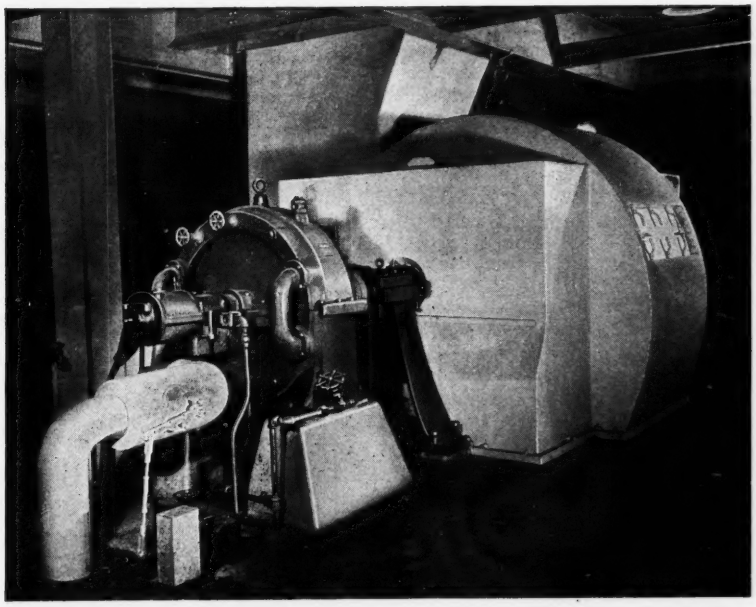
Jrl Ad N-33C-706(1)

LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

TERRY



BUCKETS AND ROTOR IN THE TERRY WHEEL TURBINE
. . ALL IN ONE PIECE

In the Terry Turbine the wheel is made from a single forging of special composition steel. The buckets are milled directly in the wheel. There are no parts to become loose or work out. Such construction makes for long life and low maintenance.

This and many other features of Terry Wheel Turbine design are described in our Bulletin S-116. A request on your business letterhead will bring a copy.

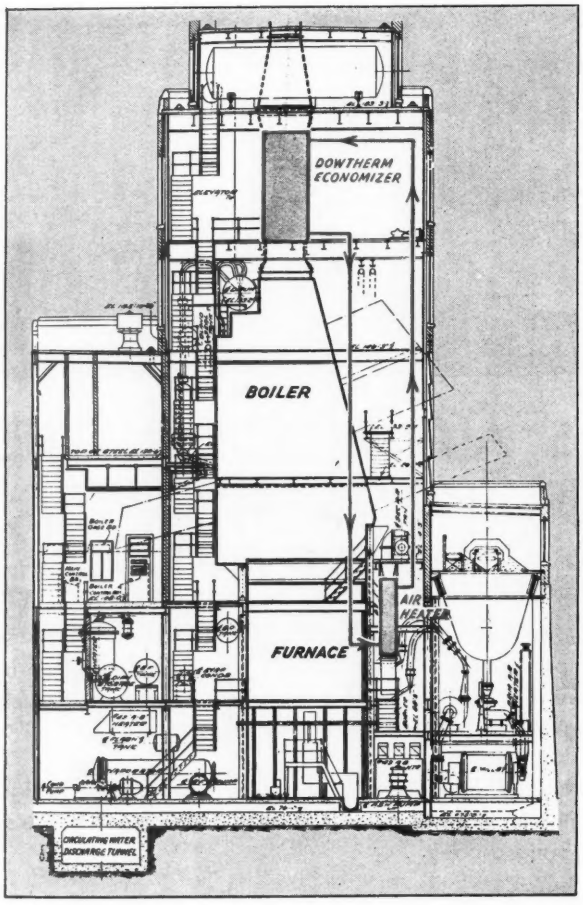
ABOVE: 250 H.P. Terry Wheel Turbine driving Induced Draft Fan. Unit is one of ten Terrys installed in a mid-western plant.

T-1153

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Blazing THE E

DOWTHERM ECONOMIZER FOR LU AIR-PREHEATING



● Complete elimination of larg preheater air ducts extending fro above the boiler to the firing floo 100 feet below, has been effecte at the Bremo Station of the Virgin Public Service Company. The cu tomary air heater, located over th boiler, was replaced by an econo mizer heating Dowtherm (not wate to 500° F. The hot Dowtherm pumped down through small diam eter lines to the burners, where it used as the heating medium i tubular air preheaters. Beside doing away with cumbersom ducts, this system reduces radi tion losses and gives individual co trol of primary and secondary a temperatures.

Foster Wheeler is a Three-Star winner under the U. S. Navy Board of Awards for production.

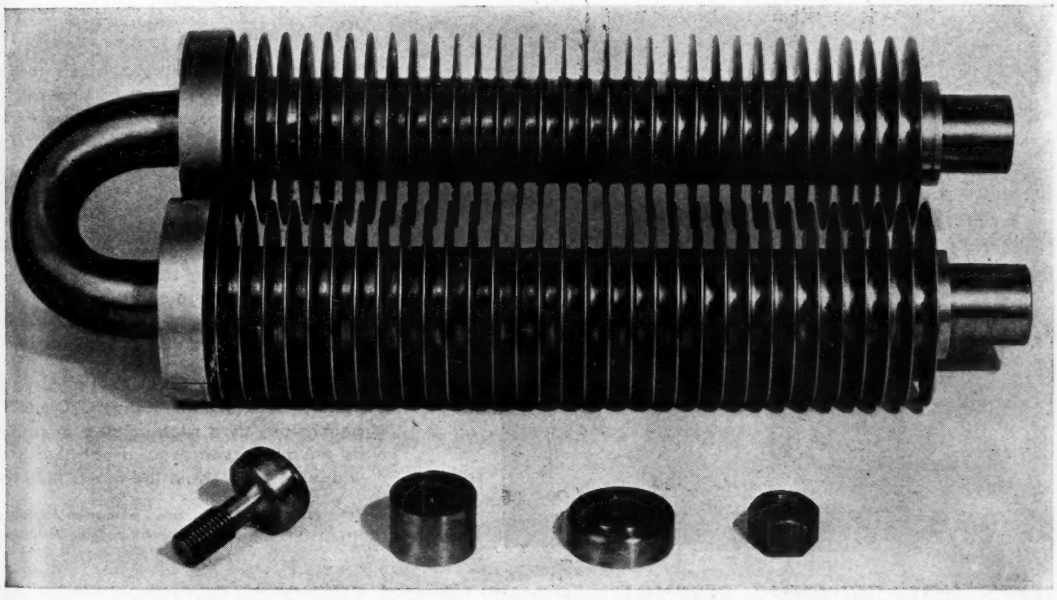
FW FOSTER W

E ENGINEERING TRAIL

ALUMINUM RING ECONOMIZER

● Twenty-four years ago, Foster Wheeler designed and commercialized the cast iron extended surface ring economizer. Performance of this high efficiency unit made it a "natural" for marine service—but its weight proved prohibitive. Exhaustive research solved the problem and a comparable light weight aluminum ring design, suitable for high pressure, was developed for the U. S. Navy.

Nine times the surface of bare tubes per lineal foot, exceptional lightness, minimum space requirements and remarkably low maintenance caused its application to merchant ships as well. The aluminum ring economizer is the finest construction in marine engineering.



FOSTER WHEELER CORPORATION

165 BROADWAY, NEW YORK 6, N. Y.

WHEELER FW

new... ELECTRONIC T

Confirms Ability of Insulation to Withstand Shorts Due to Voltage Surges

● Now, a new electronic test shows *visually* that the insulation of every coil, every turn and every phase of a G-E Tri-Clad motor winding has the strength to withstand the voltage surges that are a cause of shorts and grounds in service. Thanks to this new G-E development, no undisclosed insulation weakness can "get by."

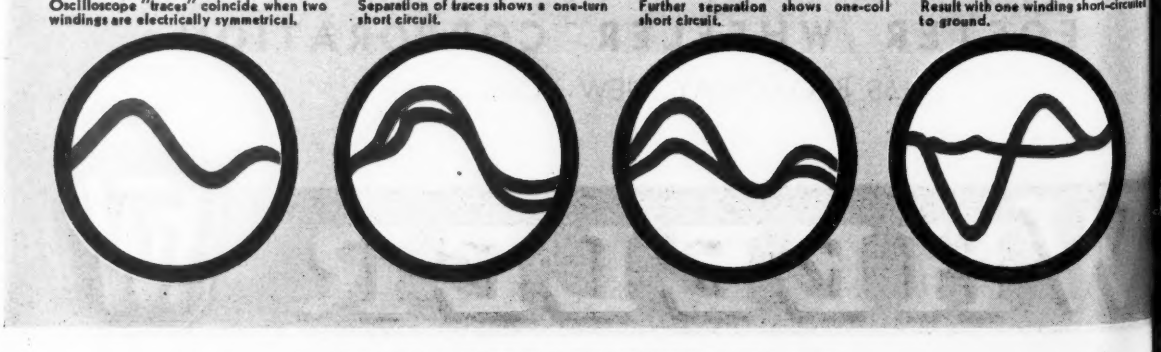
The new test method* subjects each coil in the assembled motor to a steep-front surge impulse, similar to a high-voltage transient of actual service. A cathode-ray oscilloscope indicates the performance of the winding under this sudden stress.

Only a motor with perfect insulation, and with the phases symmetrical, will give a single, clear-cut "standing wave" on the screen. The test indicates not only the condition of turn-to-turn insulation, but also that of coil-to-coil and coil-to-ground insulation.

This test is now applied to all G-E Tri-Clad motors, and to many other G-E motors and generators, as a regular step in production. Its advantages are so great that its use is widening throughout the motor industry.

*For complete details, see "Insulation Testing of Electric Windings," Trans. of A.I.E.E., Vol. 62, pp. 203-206.

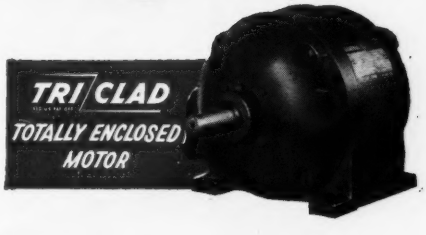
HERE'S HOW WINDING STRENGTH SHOWS UP ON THE OSCILLOSCOPE "WINDOW"


Oscilloscope "traces" coincide when two windings are electrically symmetrical.
Separation of traces shows a one-turn short circuit.
Further separation shows one-coil short circuit.
Result with one winding short-circuited to ground.

TEST Tells the "Inside Story" of Motor Windings

Production-line test of G-E Tri-Clad motors with new electronic tester. Operator turns transfer switch to take reading on each phase.

An Individual Check of Each TRI CLAD Motor Gives Extra Assurance of Unfailing Service



At each Tri-Clad motor factory, a production-line test setup like the one shown above is regularly in service. The motor windings are checked by this new test as an *additional* step in G.E.'s strict testing procedure. Other winding tests include the high-potential and high-frequency tests, in addition to many quality tests made on Formex* wire and other winding materials before they are used in the motor windings. Whenever you buy or specify a G-E Tri-Clad motor for your plant or machine, you get extra assurance of unfailing service. *General Electric Company, Schenectady, N. Y.*

*Reg. U. S. Pat. Office.

Every week 192,000 G-E employees buy more than a million dollars' worth of War Bonds.

GENERAL ELECTRIC

*Steam

* This is the 9th of a series of informative messages concerning the meaning and significance of commonly used tests and terms employed to describe the characteristics of lubricating oils.

SCIENTIFICALLY ENGINEERED FOR EVERY INDUSTRIAL USE **TYCOL**

emulsion

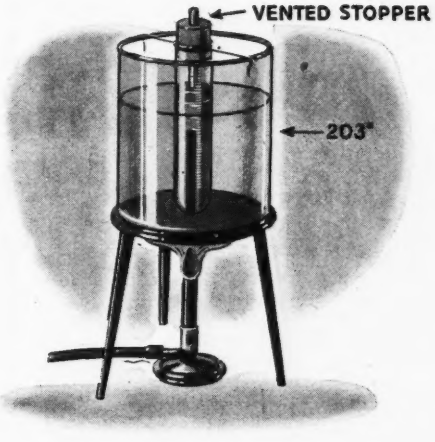
TIDE WATER LUBRICANIA

DEFINITION: The A.S.T.M. Steam Emulsion Number (S. E. No.) is the number of seconds required for an oil to separate when emulsified with condensed steam and separated under definitely prescribed conditions.

TEST: A predetermined volume of the oil is placed in a test tube of prescribed size, which in turn is placed in a bath of water. A steam delivery tube is inserted into the oil extending to the bottom of the container. Steam is passed into the oil at such a rate as to maintain the temperature of the oil at 190-195°F. until the volume of the emulsion of oil and condensed steam is 40 ± 3 ml. The test tube containing the oil is next transferred to a separating bath maintained at a temperature of 200°F. to 203°F. The contents of the oil container is examined every 30 seconds. The time in seconds required for the separation of the 20 ml. of oil is reported as the A.S.T.M. Steam Emulsion Number.

SIGNIFICANCE: (S. E. Number) when applied to an unused oil indicates whether certain compounds (soaps, sulphonates and other emulsifying agents) or contaminants in an oil have been removed in the refining process. Changes in S. E. Number may occur during storage as well as in service. It may be stated that in general, the S. E. Number is not necessarily related to the oil's performance characteristics as a lubricant.

S. E. Number is sometimes included in the specification for certain oils, but there is no uniformity of opinion as to its practical value. This test as applied to used oils may be considered as of little significance.



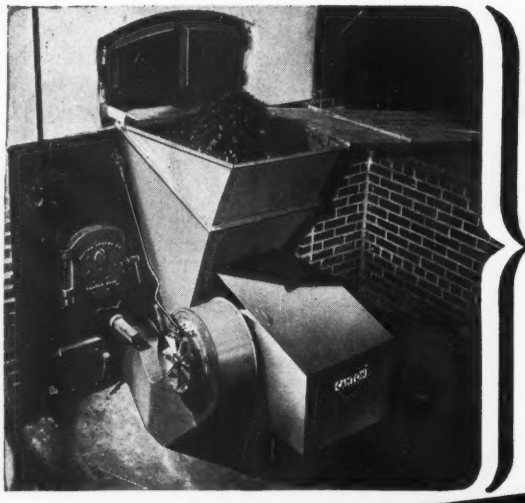
Tycol lubricants are made from the most suitable materials. They are scientifically refined to meet stringent laboratory specifications and the recommended service requirement. It is this combination that assures the outstanding performance of Tycol Industrial Oils and Greases.

TIDE WATER ASSOCIATED OIL COMPANY

MAKERS OF THE FAMOUS VEEDOL MOTOR OIL • Eastern Division: 17 Battery Place, New York 4, N. Y.

Principal Branch Offices: Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

INDUSTRIAL LUBRICANTS



BIG SAVINGS WITH COAL OVER OIL

AT THE VICTOR SILK HOSIERY COMPANY

Mr. E. Albin Drechsel, Vice President of Victor, pays their Canton LO-SET Ramfeed Stoker a fine tribute, saying, "There has been definitely a cash saving to us . . . We can now carry a full head of steam with a capacity load . . . it has never given us any trouble and under present conditions WE WOULD NEVER THINK OF GOING BACK TO OIL."

CANTON STOKER

Performance?

LET'S GET DOWN TO CASES

LOW COST STEAM – UNIT HEATING COST 20c Per Day

AT MORIN HEIGHTS HOUSING PROJECT, WOONSOCKET, R. I.

Three boilers fired with Canton LO-SET Ramfeed Stokers furnish heat and hot water from a central heating plant to the 300 housing units at the Morin Heights Housing project. George Fleurant, superintendent, heartily endorses the Canton Stokers stating, "they are standing up one hundred per cent . . . our test runs prove that only 6½ tons of coal are used in sixteen hours, with ACTUAL COST ABOUT TWENTY CENTS PER DAY for each housing unit."

CONTINUOUS OPERATION – HEAVY OVERLOAD CARRIED WITH NO SHUTDOWNS

AT COPPERWELD STEEL COMPANY, WARREN, OHIO

A 450 H.P. heating load, seventeen pickling tanks and a thousand ton press require large quantities of steam at Copperweld Steel. While awaiting delivery of the 3rd and 4th boilers during the winter of 1942-43, two of the four Canton Stokers purchased were on the line continuously—no let-down was possible. Mr. Morgan, chief engineer reports, "In periods of heavy demand with wide fluctuations, steam pressures held constant."

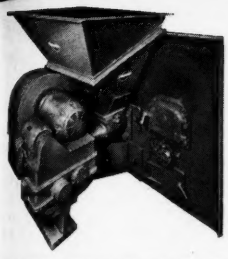
CANTON STOKERS SAVE VITAL FUEL, MANPOWER AND TRANSPORTATION

CANTON STOKER

. . . SOME TYPICAL EXAMPLES OF CANTON'S EFFICIENCY, DEPENDABILITY AND ECONOMICAL SERVICE . . . .

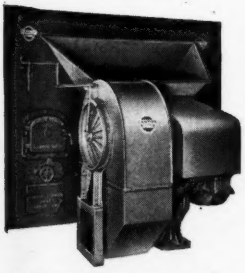
54 TYPES AND SIZES FOR EACH NEED UP TO 800 H.P.

Canton Ramfeed and Wormfeed Stokers are literally engineered for each specific job. You can be certain after thorough analysis of your need, that the Canton model selected will meet all requirements.



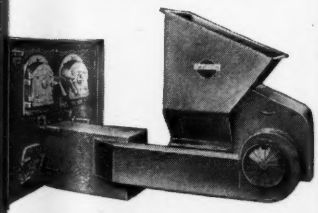
CANTON UNIFLEX RAMFEED

Compact arrangement—front motor mounting, separate fan drive—engineered for limited space installations.



CANTON VULCAN RAMFEED

Ruggedly constructed and engineered for heaviest loads — also available in LO-SET models. Famous for carrying high overload capacities.



CANTON DELUX UNIT WORMFEED

Side dump stoker — front fan mounting — zoned air control — especially adaptable to converting existing boilers to stoker firing.

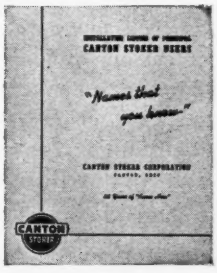
The three installations described are being duplicated in hundreds of plants where Canton Stokers serve—top efficiency, fuel saving (so vital to the war effort) and low maintenance costs are the qualities that make Canton Stoker a "best buy."

CANTON STOKERS *Guaranteed* 5 YEARS

Reflecting the rugged design and sound engineering is the EXCLUSIVE 5 year Canton Guarantee—a guarantee covering not only defects but wear itself. Canton Stokers are the ONLY stokers offering this protective bond.

HUNDREDS OF SATISFIED CUSTOMERS

Indicating the success of Canton Stokers "on the job" is the list of "famous name" plants Canton Stoker equipped — Send for your copy of this interesting twelve page brochure today.



Now **IMMEDIATE DELIVERY FROM STOCK**

TO REPLACE OIL, GAS, OR HAND FIRING EQUIPMENT

Send Today for Descriptive Literature and Cost Saving Facts

THERE ARE 32 YEARS OF *"Know How"* BEHIND CANTON STOKERS

★

Representatives In Principal Cities

CANTON STOKER CORPORATION

900 ANDREW PLACE, S. W., CANTON, OHIO

Gentlemen:

---Please send all descriptive literature at once

---Have a CANTON Engineer interview us immediately

Name _____

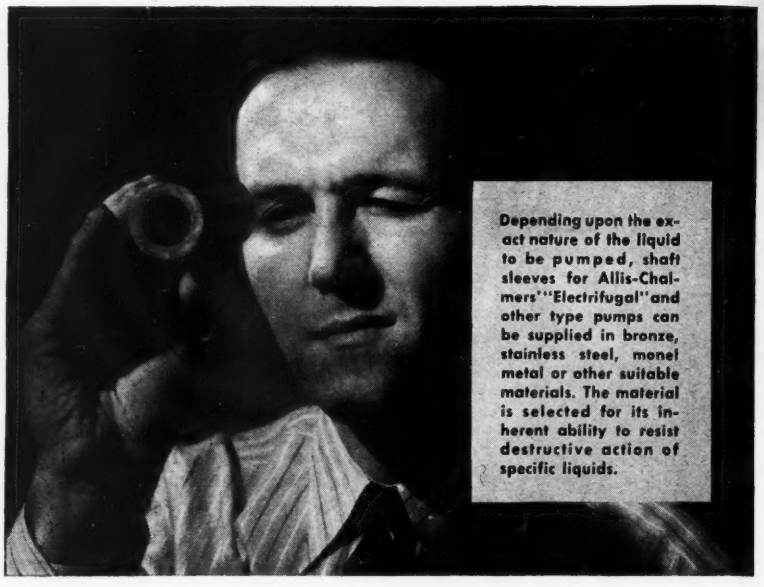
Company _____

Address _____

City _____ State _____

[PUMP TIPS FROM ALLIS-CHALMERS—ONE IN A SERIES]

How to make SLEEVES Last Longer . . .



Depending upon the exact nature of the liquid to be pumped, shaft sleeves for Allis-Chalmers' "Electrifugal" and other type pumps can be supplied in bronze, stainless steel, monel metal or other suitable materials. The material is selected for its inherent ability to resist destructive action of specific liquids.

AS WITH MANY pump troubles, excessive sleeve wear is apt to trace back to misalignment of pump and motor. For when shaft is deflected, sleeve is apt to wobble within the packing — accelerating friction and wear.

So serious is this problem of misalignment, that Allis-Chalmers engineers were led to develop, for many applications, the famous "Electrifugal" pump — in which both the motor and pump impeller are mounted on one shaft and in one frame.

In such a pump the elements cannot get out of line — and danger of excessive sleeve wear is minimized. However, many pumps in use today are separate from their driving motors — and the coupling flanges must be carefully aligned . . . and *kept* in alignment!

Here are other ways to extend sleeve life:

▶ Don't draw stuffing box gland too tightly . . . excessive pressure will wear shaft sleeves unduly.

▶ Never pump a liquid for which your pump was not designed. Sleeves are able to withstand corrosive effects of some but not necessarily all liquids. When in doubt over safety of changing pump application, check with your manufacturer.

▶ Generally a thin stream of liquid being pumped serves as a water seal between packing and sleeve. If it is dirty or abrasive, a separate supply of sealing liquid should be obtained. And it should reach the sleeve in a steady supply. Be careful water seal piping isn't plugged — or lantern ring displaced.

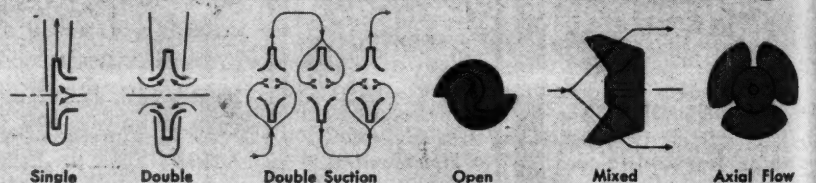
▶ Send for your *free* copy of Allis-Chalmers' "Handbook for Wartime Care of Centrifugal pumps". This valuable booklet applies to *all* makes of pumps. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS.

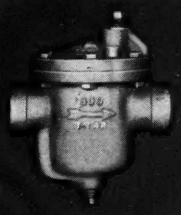
♪ *Tune in the Boston Symphony, Blue Network, every Sat. Eve.*

A 1708

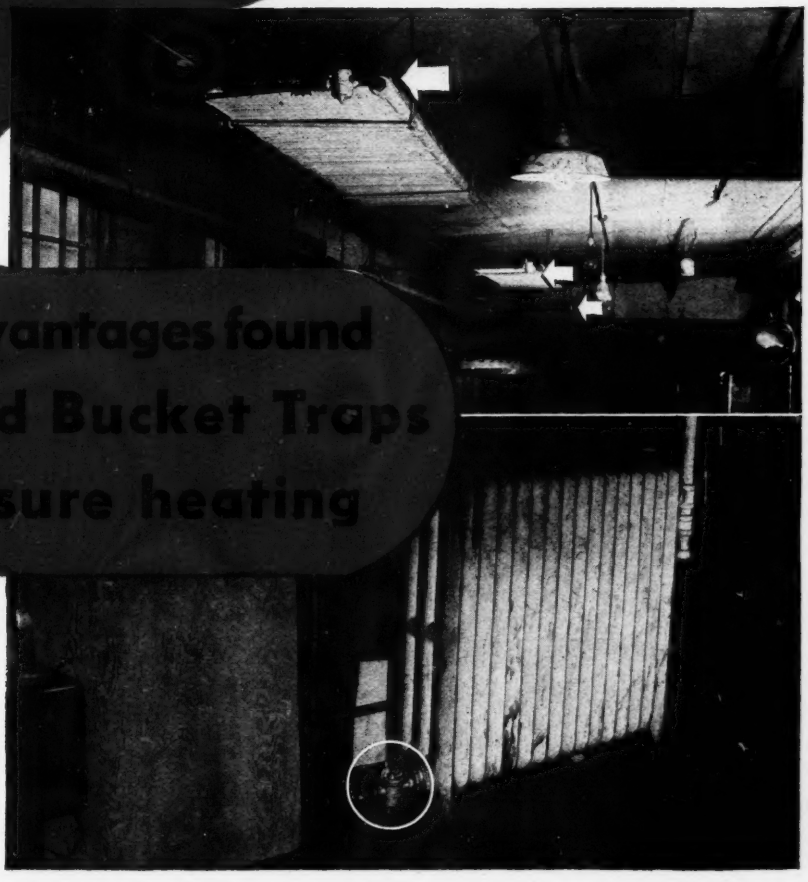
ALLIS-CHALMERS PUMPS

Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 lbs.





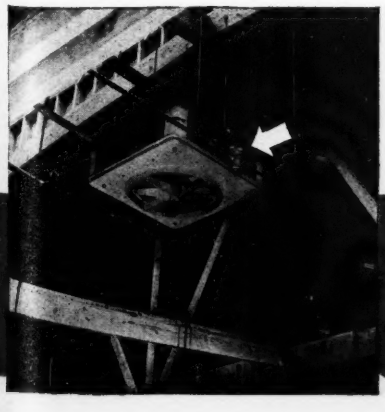
Impressive advantages found with Inverted Bucket Traps for low-pressure heating



At right: *Armstrong traps on overhead and floor radiators.*

THE swing towards Armstrong inverted bucket traps for low pressure heating and process use is due to two factors. One is that heating experience is showing that in most cases this type of trap gives better performance at less net cost per year. On maintenance alone, many trap owners have found that their expense on "low-pressure" traps on easy service was greater than on Armstrong traps for high pressure, heavy duty service. It is not unusual for Armstrong traps to operate many years with no maintenance expense whatever. In a Minneapolis hospital, for example, 34 traps installed for periods up to eight years, many of them on vacuum service, required not a single cent for repair parts.

Below: *Armstrong trap draining unit heater in large dairy plant.*



Survey shows better performance with Armstrong Traps, at less cost

The other factor is that the Armstrong design removed the principal objection to mechanical traps which did not have adequate air venting capacity. The standard Armstrong traps remove large quantities of air; and where required, traps with large thermostatically controlled bucket vents remove air at the rate of 500 to 1500 cu. ft. of free air per hour.

And since steam leaks have been eliminated in the Armstrong design, all the features add up to high returns on the trapping investment. In a greenhouse, for example, replacement of bellows type traps by Armstrongs resulted in holding temperatures uniform to within one degree where previously they had fluctuated as much as 12°. Furthermore, this was accomplished with a reduction of 30% in the amount of pipe coil radiation.

40% faster PROCESS HEATING

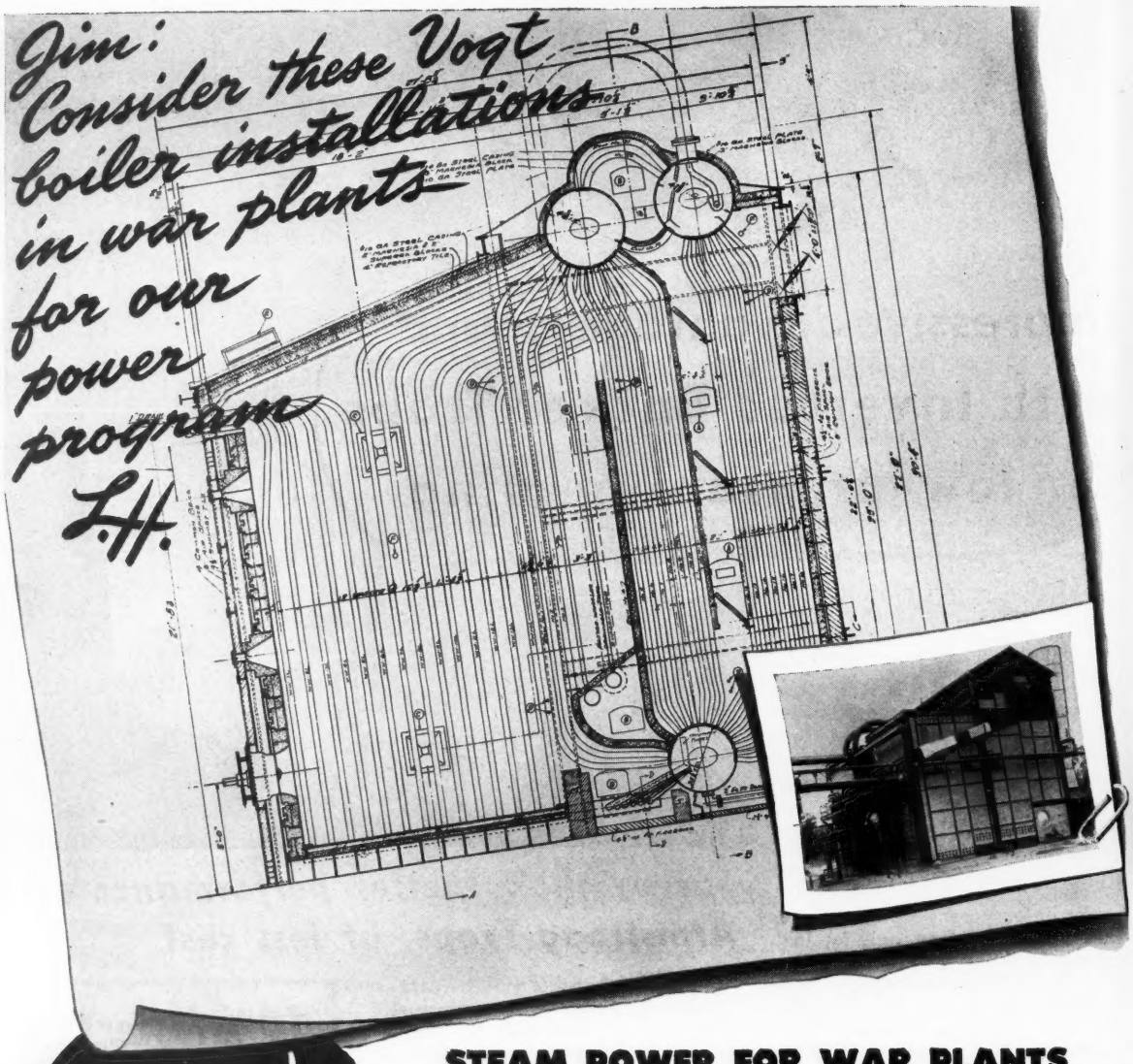
Of reports that have been turned in over 13 years dealing with faster heating secured by Armstrong trapping, those that gave figures show an average speed up of 40%.

The Armstrong Steam Trap Book contains interesting studies on low and high pressure trapping. We'll be glad to send you a copy. ARMSTRONG MACHINE WORKS, 810 Maple Street, Three Rivers, Michigan.

Armstrong

Steam Traps — Air Traps — Pumps — Humidifiers

Jim: Consider these Vogt boiler installations in war plants for our power program
L.H.



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CLASS VR
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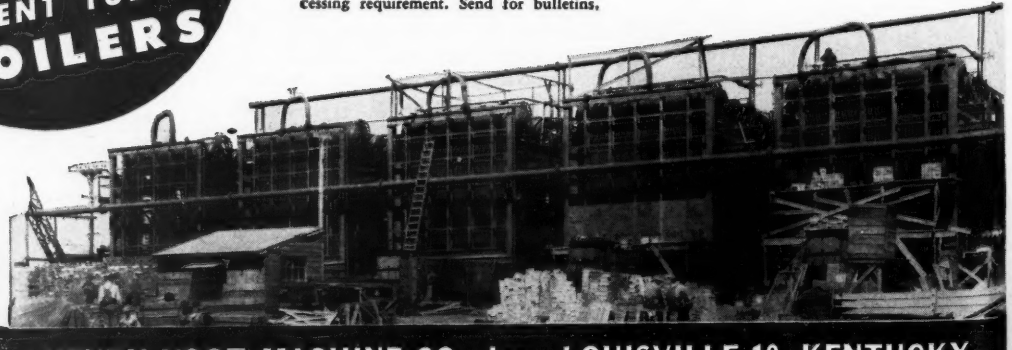
STEAM POWER FOR WAR PLANTS

These Oil and Gas Fired Steam Generators are working round-the-clock in war plants producing 100 octane gasoline and synthetic rubber components . . . all vital to Victory!

Vogt builds steam generating equipment to meet every power, heating, or processing requirement. Send for bulletins.



HENRY VOGT MACHINE CO., Inc., LOUISVILLE 10, KENTUCKY
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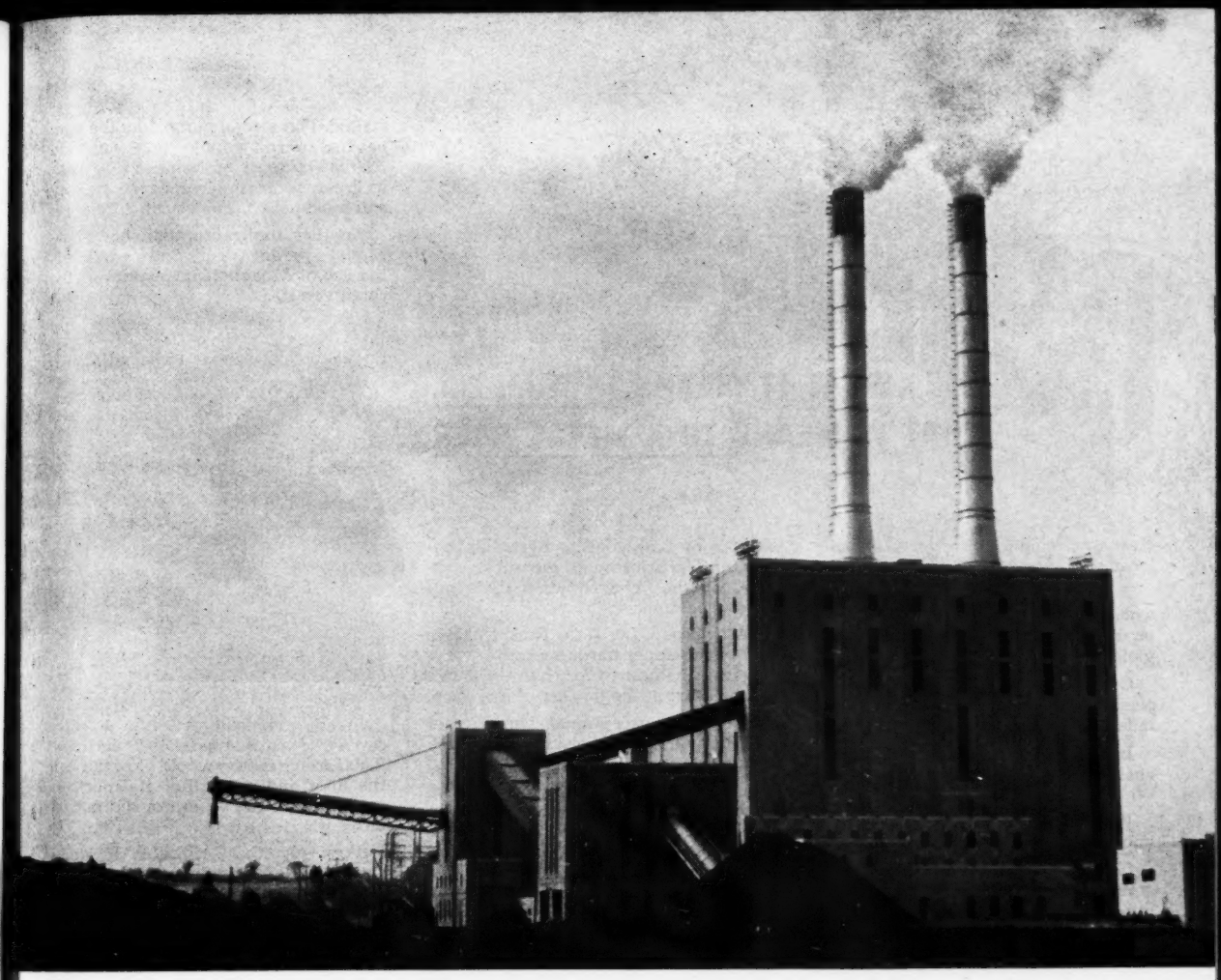


At this modern power station, coal is efficiently handled u an S-A Engineered System using Belt Conveyors, REDL Conveyor-Elevators, Knittel Crushers and Pan Feeders.

The Key to Fast, Efficient Coal Handling . . .

S-A EQUIPMENT *Plus* S-A ENGINEERING

★ At many of the nation's largest generating plants, as well as in countless smaller power plants, Stephens-Adamson Coal Handling Machinery has made possible *low handling cost per ton.*

This is a result of careful planning by experienced S-A Engineers plus the application of the proper conveying units selected from S-A's complete line of Material Handling Equipment.

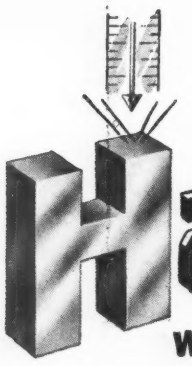
S-A is thoroughly qualified by forty-two years of experience to serve both in the capacity of consultant on handling problems and as a supplier of conveying and elevating machinery.

STEPHEN S-A ADAMSON MFG. CO.

515 RIDGEWAY AVENUE, AURORA, ILLINOIS — LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT



Hardness

...WHAT IT MEANS IN A METAL
WHAT IT MEANS TO A METAL USER

Next to strength, the property usually most sought in a metal is *hardness.*

A dictionary calls a material hard when it is "not easily penetrated, cut, or separated into parts, not easily yielding to pressure."

Others call it "the ability to resist plastic deformation," and "resistance to indentation or penetration."

In short, an exact definition of hardness seems to have stumped even Webster.

What hardness *is,* however, is not so important as what it *does.*

Generally, the harder a metal, the greater its resistance to frictional wear, the better it fights the blasting action of grit and other abrasive substances, and the longer it holds off the erosive effect of steam or water. A hard metal usually does not gall or seize as quickly as a softer one.

Though hardness must share credit with toughness and ductility for resisting most forms of wear, hardness usually gets the nod as the most important of the three.

Since no one method of hardness testing is applicable to all shapes of materials, several types of testing machines have been developed. Of these, the Brinell, Rockwell and Vickers machines are basically similar, as all measure penetration of the metal under test . . . by ball, cone or pyramidal indenter. The Scleroscope measures hardness by the "bounce" of a diamond-tipped hammer.

As a group, the INCO Nickel Alloys are in the upper hardness range, varying from medium to very hard, as shown in the chart at the bottom of this page.

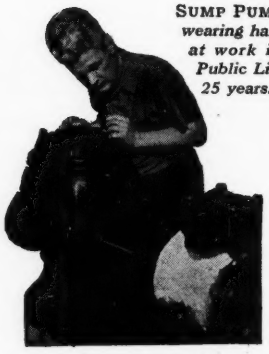
Note the exceptional hardness of "K" Monel, "Z" Nickel, and "S" Monel.

"K" Monel can be heat-treated after finishing, for applications that require a corrosion-resisting material with extremely high strength and hardness. "S" Monel is an extremely hard and strong cast alloy for non-galling valve trim, pump liners, etc. It retains high hardness at red heat. "Z" Nickel, one of the hardest non-ferrous alloys obtainable, can be heat-treated after forming to develop 2½ to 4 times the strength of structural steel.

The practical advantages of hardness are illustrated by the record of the Monel rods in the pump shown above. The pump has been at work since 1918, handling gritty waters from ash quenching and corrosive waters from coal drainage. The Monel rods have given trouble-free service during the whole quarter-century.

A second pump was installed ten years after the first. Its rods were made of bronze. Three sets failed in less than 10 years. Monel rods were then installed. The second pump, like the first, has had no rod trouble since that time . . . the *hardness* of Monel along with its greater corrosion resistance, rigidity and toughness has made the difference.

Another application that shows how Monel's hardness cuts down trouble is the use of Monel steam separators for cargo vessels.

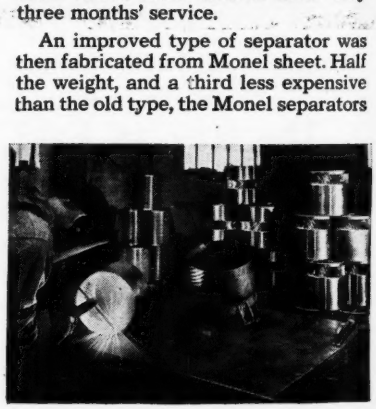


SUMP PUMP *with long-wearing hard Monel rods at work in New York Public Library for over 25 years.*

Steam coming direct from a boiler carries moisture and solid particles. This foreign matter would blow through the lines and erode the vital parts of equipment if the separator did not remove it.

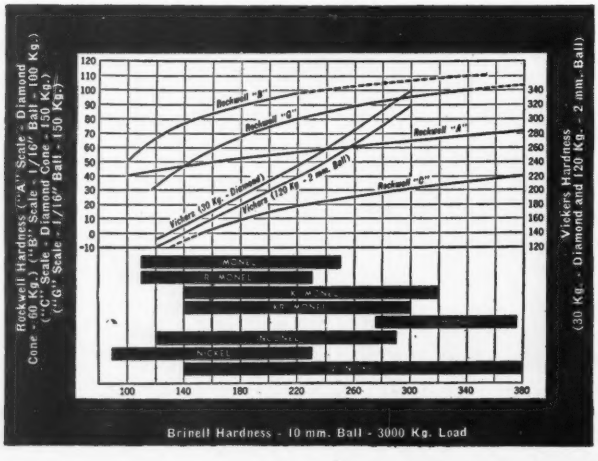
Formerly, the Dri-Steam Products Co. used thick castings of a softer corrosion-resistant metal as inner cylinders for the separators. The cylinders often failed from erosion after only three months' service.

An improved type of separator was then fabricated from Monel sheet. Half the weight, and a third less expensive than the old type, the Monel separators have been in use for over two years. Not one has failed . . . Monel's added hardness has again produced longer, trouble-free life.



STEAM SEPARATORS *of hard Monel sheet, cut cost 30%, weight 50% . . . and give over 8 times the service of former type. Made by Dri-Steam Products Co., New York, N. Y.*

For further light on hardness . . . and on other mechanical properties that determine a metal's suitability for specific applications . . . write for a copy of the 26-page bulletin, "The Technical Editor speaks . . ." A copy is yours for the asking.


Rockwell Hardness ("A" Scale - Diamond Cone - 60 Kg. Load; 1/16" Ball - 100 Kg.)
("C" Scale - Diamond Cone - 150 Kg.)
("G" Scale - 1/16" Ball - 150 Kg.)
Rockwell "B"
Rockwell "G"
Rockwell "A"
Rockwell "C"
Vickers (30 Kg. - Diamond)
Vickers (120 Kg. - 2 mm. Ball)
MONEL
K-MONEL
S-MONEL
NICKEL
Vickers Hardness (30 Kg. - Diamond and 120 Kg. - 2 mm. Ball)
Brinell Hardness - 10 mm. Ball - 3000 Kg. Load

HARDNESS OF INCO NICKEL ALLOYS. *The hardness range of each alloy is shown by the horizontal bars; the approximate relation between Brinell, Rockwell and Vickers hardness numbers is shown by the conversion chart.*

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall St., New York 5, N.Y.

A N N O U N C I N G

A New and Advanced

BOILER RATIO METER *by* COCHRANE

THE Cochrane Corporation offers to the power plant field a new boiler meter of the steam-flow, air-flow type known as the Cochrane Boiler Ratio Meter. This meter has several important advantages over other constructions. An easily adjustable cam in the air flow mechanism permits the operator to establish the relation of air supply to fuel supply (measured by steam generated) most favorable for his particular operation. In addition, a red indication pointer operating across a white 10" scale makes it unnecessary to examine closely the position of the pens to determine whether the air is excessive or insufficient, for the movement of the pointer is 3 times as great as the difference between the pens. The steam flow mechanism is the well-known Cochrane Friction-Free Electric Flow Meter, operating on the null balance principle assuring highest accuracy, while the air flow mechanism is based on the highly responsive Hays slack diaphragm, equipped with an electric motor follow-up for ample power. Intelligent use of the Cochrane Boiler Ratio Meter will result in lower operation and maintenance costs as well as greater plant capacity without increasing the size of the steam producing units or auxiliaries.

Write NOW for a copy of Publication 4071, "Double-Barreled Combustion Guidance", giving important facts about the use of boiler meters in increasing the efficiency and lowering the costs of power plant operation.

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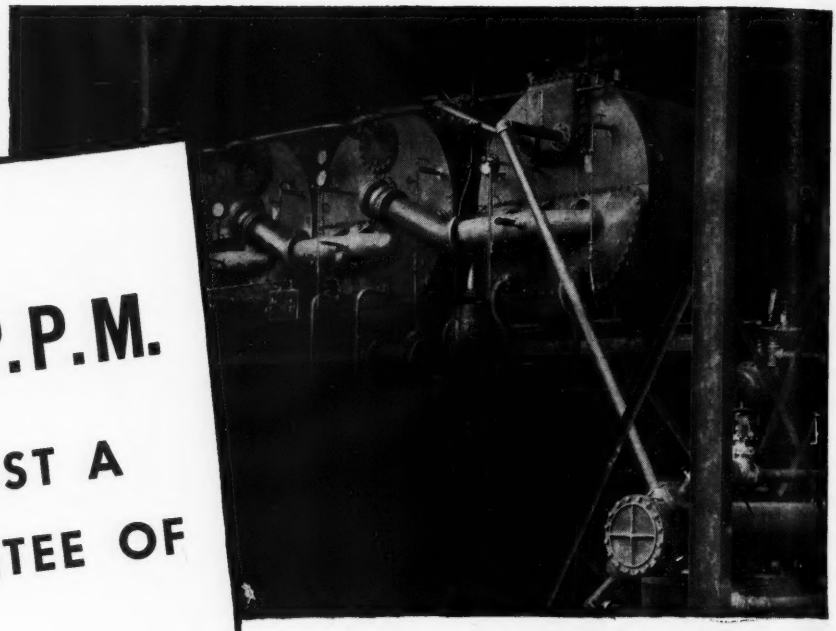
THE MOST COMPLETE LINE OF FLOW MEASURING INSTRUMENTS

COCHRANE



1.72 P.P.M.

AGAINST A GUARANTEE OF

4.3 P. P. M.

Prior to its installation, this Lummus Triple Effect Evaporator was submitted to severe factory tests. In these tests and in subsequent service the efficiency of the Lummus design was verified by the purity of the product: 1.72 P.P.M. against a specification of 4.3 P.P.M.

Lummus makes a complete line of single and multiple effect evaporators for power plant, process and marine service. These Lummus Evaporators are characterized by high efficiency, low steam consumption per pound of water produced, compact design, low scaling and other features.

The services of Lummus personnel are available for the study of power plant and process applications of evaporative and other heat exchange equipment.

Other LUMMUS Power Plant Equipment

- ★ Surface Condensers
- ★ Steam Jet Air Pumps
- ★ Bleeder Heaters
- ★ Boiler Blowdown Heat Exchangers
- ★ Evaporators
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LUMMUS

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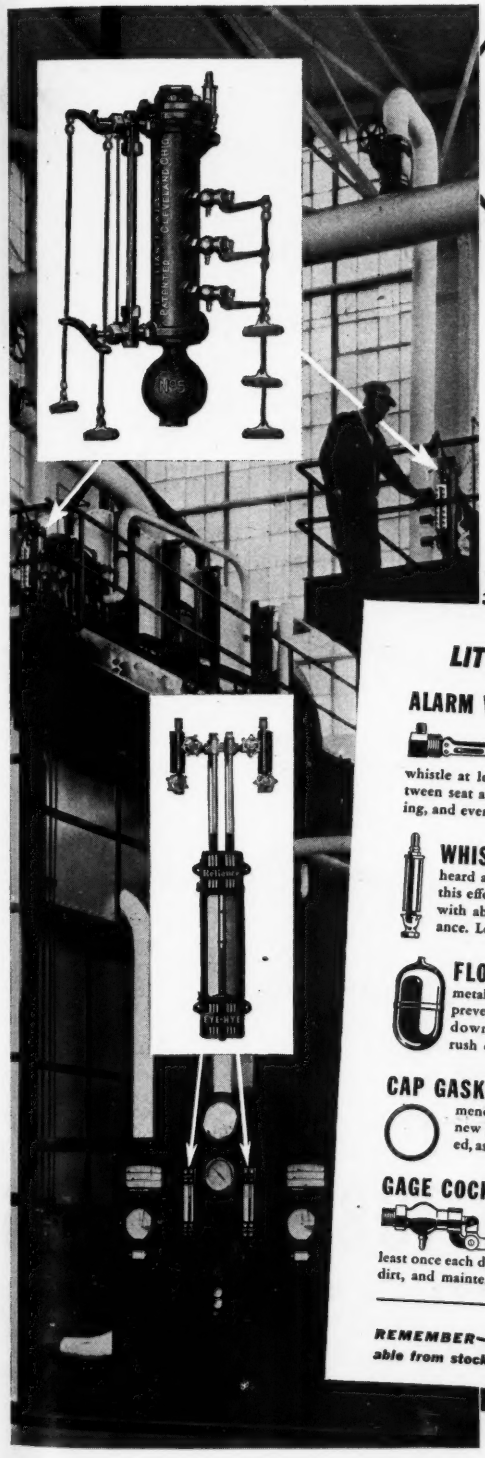
Common Sense Protection

helps you prevent boiler water level accidents



You minimize boiler outage risks by watching "small" equipment that keeps "big" equipment at work

Reliance Alarm Water Columns and EYE-HYE Remote Reading Water Level Gages are rendering staunch service in war plants and central stations. Keep them in fighting trim.

THE RELIANCE GAUGE COLUMN CO.
5902 CARNEGIE AVENUE, CLEVELAND 3, OHIO

BOILER SAFETY DEVICES since 1884

Reliance

LITTLE POINTERS THAT HELP SHOW THE WAY

ALARM VALVE has hardened stainless steel seat and cone valve to resist abuse from steam flow. Keep the ports clean by blowing whistle at least once each day. Dirt caught between seat and cone valve will cause wire drawing, and eventual leakage.

WHISTLE tone is normally shrill to be heard above boiler room noise. To obtain this effect bell must be centered over bowl with about a three-sixteenth inch clearance. Loosen acorn nut at top to adjust.

FLOAT is ruggedly built of stainless metal. Denting of lower float may be prevented by opening column blowdown valve slowly to avoid sudden rush of water.

CAP GASKET Corrugated metal is recommended for tight flange joint. Use a new gasket each time column is opened, as cheap insurance against leakage.

GAGE COCK has stainless renewable seat and cone valve. Keep the seat clean by blowdown at least once each day. *Blow thoroughly* to remove all dirt, and maintenance seldom will be required.

***REMEMBER*—replacement parts are available from stock on MRO priority.**

GAGE VALVE Keep stem and glass end stuffing box tight, to prevent steam leakage and unsightly appearance. Moulded metalastic packing for stem end and rubber composition for tubular glass. Valves must be in perfect vertical alignment for safe glass installation.

EYE-HYE VALVE on blowdown lines must be absolutely tight, which is also true of all other *joints* of the installation if satisfactory operation is to be had. Valves controlling boiler pressure to EYE-HYE should be wide open when EYE-HYE is in service.

EYE-HYE PLUG GASKET Metal covered asbestos makes resilient, easy seal, and can be used more than once. Renew them when crushed from use, as leakage should be avoided.

VIZZENE FLUID is a special compound having specific and important characteristics keyed to your EYE-HYE. It is unobtainable except from factory or authorized representatives. Order by *letter* stamped on EYE-HYE name plate.

CLEANING FLUID makes the chore of cleaning EYE-HYE simple as A, B, C. Can be used several times over and is handy for other small cleaning jobs where dirt must be removed from the interior of equipment.

New *Efficiency* for old condensers

TODAY'S REQUIREMENTS are for *higher* water velocities — *higher* temperatures — *higher* pressures—heavily increasing burdens on condenser tubes. **JOHN CRANE CONDENSER PACKINGS** are engineered for *duties now, and in the future.* You will find that the *most efficient* condensers have John Crane **CONDENSER PACKING . . . used** on hundreds of ships and stationary installations.

THESE ARE THE ADVANTAGES

- Easy to install—no special tools required
- Permit quick renewals of tubes in operation
- Reduce cost of retubing and repacking
- Bond tubes to sheets, reducing electrolytic action
- No deformation of tube ends, as by ferrule pressure
- Eliminate costly ferrules
- Permit free expansion and contraction of tubes in temperature changes
- Seal tubes tightly in all heat transfer equipment
- Outlast life of tubes
- Not affected by contaminated or chemically treated water

Remarkable progress has been made in condenser efficiency, and the Crane Packing Company has pioneered every improved condenser packing development. Write for this story and descriptive literature.

John CRANE
METALLIC CONDENSER TUBE PACKING

FOR OLD AND NEW CONDENSERS

CRANE PACKING COMPANY, 1812 CUYLER AVE. • CHICAGO 13, ILL.

BRANCHES: Baltimore, Boston, Buffalo, Cleveland, Dallas, Detroit, Houston, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Seattle, Tulsa. *IN CANADA:* CRANE PACKING COMPANY, LTD., Hamilton, Ontario, with branches at Vancouver, Toronto and Montreal.

SPEEDING V-DAY

From butadiene comes the fighting rubber for the battle fronts . . . the cushions for the wheels of industry. In plants like these, devoted to the manufacture of butadiene, Ladish forged steel flanges are doing their part in the development of synthetic rubber —speeding the day of victory.

ARMY E NAVY

FITTINGS DIVISION

TO MARK PROGRESS

LADISH DROP FORGE CO.

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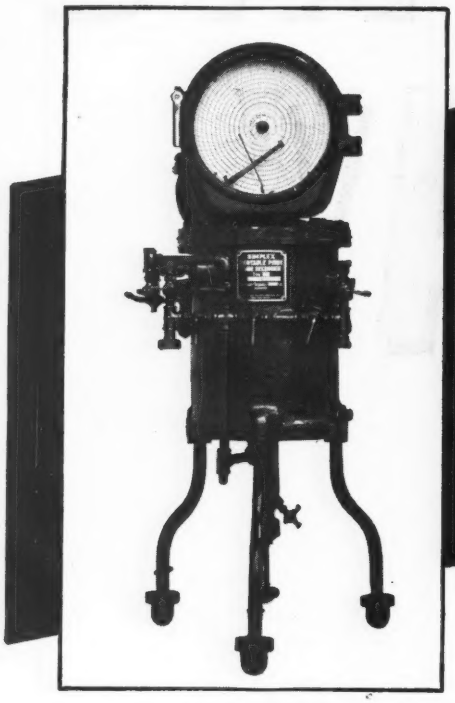
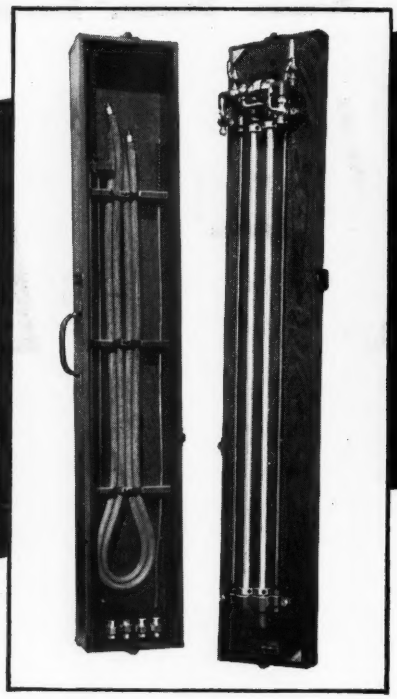
MILWAUKEE SUBURB

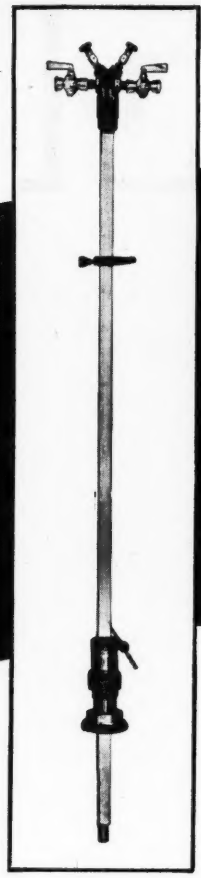
Are You "Saving at the Bung and Losing at the Seams?"



SIMPLEX RECORDER



TYPE MAC SIMPLEX PORTABLE MANOMETER



SIMPLEX PITOT TUBE

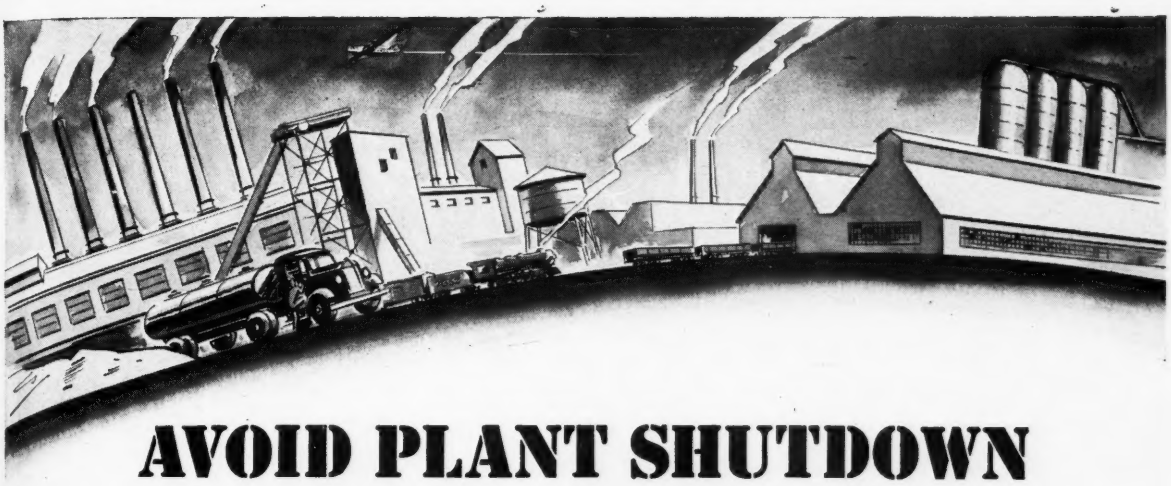
Get an up-to-the-minute overall picture of the actual operating efficiency of your water and liquid distribution systems, large pumps, meters, etc., by making a survey with Simplex Pitot Equipment.

Present day demands on all equipment in process and water supply plants is so great that inefficiencies creep in without apparent reason and sometimes escape notice. A simple test can put the finger of suspicion on the exact spot where trouble is occurring.

A complete checking survey of your distribution lines, and units in those lines, involves very little time, and the expenditure of an almost negligible amount of money. Simplex has many examples showing where the entire cost of checking up was saved in one month by restoring the normal rated efficiency to equipment found to be under par.

Write today for Simplex Bulletin 200 — Manometers; Simplex Bulletins 22, 23, 24 — Pitot Equipment and Theory. Copies will be sent without obligation on request.

SIMPLEX VALVE & METER COMPANY
6783 UPLAND STREET, PHILADELPHIA, PENNA.



AVOID PLANT SHUTDOWN due to GAS SHORTAGE

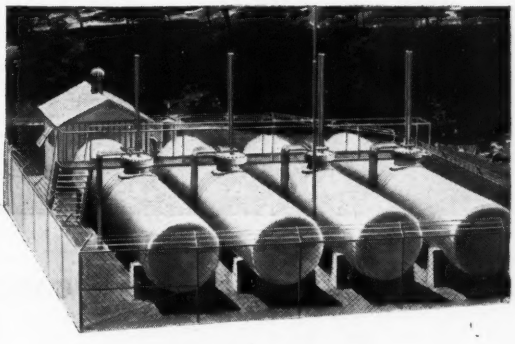
WHY risk unnecessary production losses, or interrupted service to customers, because of gas failure or shortage? Install a Pritchard Gas Standby Plant.

Gas Standby Plants are reliable, ever alert, ready to assume the full load in a matter of minutes when regular service is interrupted.

Pritchard Standby Plants are independent units, complete within themselves, delivering gas that is used in usual appliances without special adjustments for proper combustion.

Investigate today. Write for complete information concerning application of Standby Gas Plants.

J. F. PRITCHARD & CO., *Gas Division,* Fidelity Building, Kansas City, Missouri



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ENGINEERS AND CONSTRUCTORS
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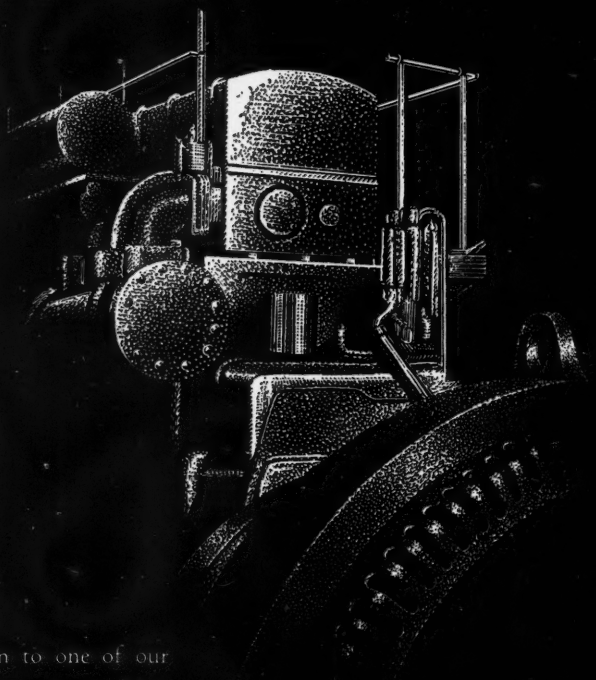
Manufacturers of Mechanical and Atmospheric Cooling Towers

EXAMPLE OF *Service*:



A large company put this problem to one of our Cities Service Diesel Lubrication Engineers: "How can we reduce Diesel breakdowns that are seriously interfering with production?"... Our engineer studied the facts and recommended a special Cities Service Diesel lubricant. In 38 months since, Diesel efficiency has been steadily maintained, with engine overhauls reduced by the amazing figure of 30%.

More and more, it's service that counts...

and *Cities Service* means good service!

CITIES SERVICE OILS — ONCE-ALWAYS

CITIES SERVICE OIL COMPANY

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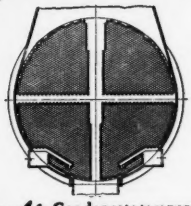
28 Years of C. H. Wheeler DUAL BANK CONDENSERS

KEEP PACE WITH IMPROVEMENTS IN TURBINE DESIGN

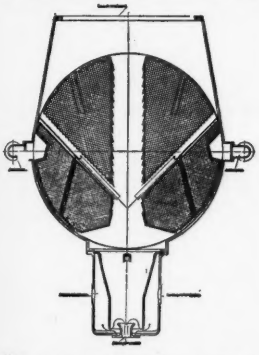
As the Steam Turbine was developed for higher vacuum, C. H. Wheeler Condensers kept apace of the same trend.

1916 **THE FIRST C. H. WHEELER CONDENSER** with which the steam ejector type air pumps were used is shown by this actual installation tube sheet.



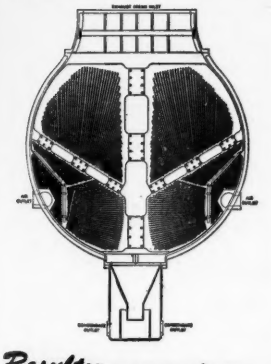
Result: Condensate temperatures within 5° of temperatures corresponding to vacuum.

1923 **IMPROVEMENT:** Wider steam lane and hotter condensate—shown in literature published at that time.



Result: This produced condensate temperature corresponding to temperature of vacuum and the oxygen content was less than 0.03 cc per litre.

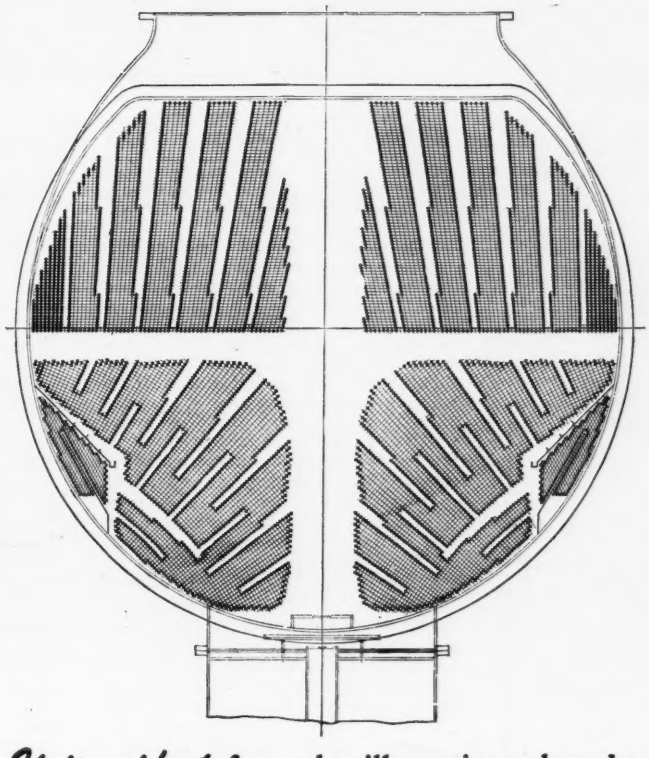
1929 **FURTHER IMPROVEMENT:** More open area for entering steam—illustrated in literature published at that time.



Result: Less pressure drop.

1944

NOW—Additional steam lanes give deeper penetration for the entering steam!



It is evident from the illustrations that the C. H. Wheeler Manufacturing Company has pioneered the development of this highly efficient Dual Bank Condenser.

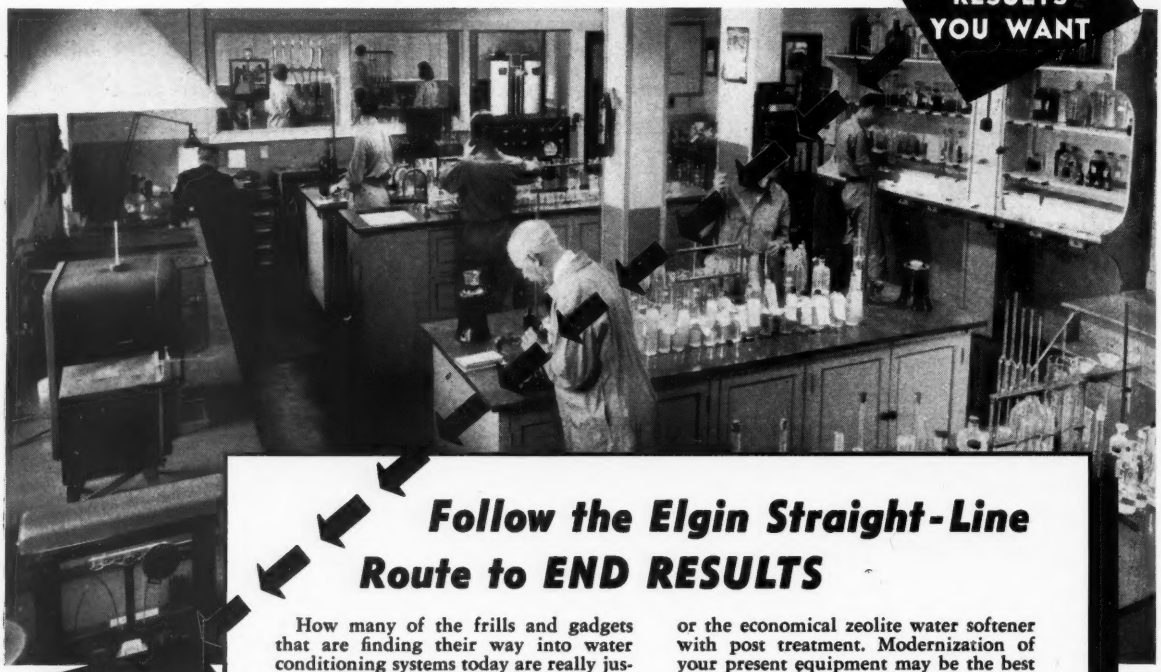
PRODUCTS: Surface Condensers • Steam Jet Ejectors • Cooling Towers • Deck Machinery

C. H. WHEELER MANUFACTURING CO.

19th ST. and LEHIGH AVE., PHILADELPHIA, PA. *of Philadelphia*

How to save Dollars in Boiler Water Conditioning

THE RESULTS YOU WANT



THE SYSTEM TO USE

Follow the Elgin Straight-Line Route to END RESULTS

How many of the frills and gadgets that are finding their way into water conditioning systems today are really justified? True, they may accomplish the required results, but do they give you any *extra* results to justify the *extra* investment and maintenance costs? And what about the obsolescence factor that always goes with innovations?

In the final analysis, the three major results you seek are clean, scale-free boilers; dry steam; freedom from corrosion and embrittlement. So, obviously, the smart and business-like thing to do is to adopt the method or system that will achieve these results most efficiently and most economically.

This is precisely the approach followed by experienced Elgin Engineers in providing effective, economical water conditioning. Their analysis of your individual requirements may suggest low-cost individually formulated chemical treatment with or without the Elgin Deconcentrator for sludge removal — or the economical zeolite water softener with post treatment. Modernization of your present equipment may be the best answer — particularly if you are using a zeolite water softener, in which case its capacity can be increased as much as 44% by means of the Elgin "Double-Check" type manifold system and Elgin Zeolite.

But whatever our recommendation, you can be sure it will be that system which most economically provides those *final* objectives: clean boilers, dry steam and freedom from corrosion and embrittlement of boiler metal. An elaborate system will not be recommended unless thoroughly justified by sound analysis of investment and operating costs.

Yes, despite the fact that Elgin is in a position to give you any authoritative method or equipment, the Elgin policy is to follow the straight line to practical results at minimum cost. One of our district engineers would like to show you exactly what we mean in terms of your specific needs. No obligation whatever is involved.

ELGIN SOFTENER CORPORATION
136 North Grove Avenue, Elgin, Illinois

ELGIN
ECONOMICAL
WATER CONDITIONING

THE COMPLETE ELGIN LINE

Boiler Water Treating and Purifying Systems • Feedwater Treatment • Deconcentrators • Heat Exchangers • Water Softeners Filters and Purifiers • Iron Removal Equipment • Aerators • Water Treating Chemicals • Chemical Feeders • Scale and Corrosion Inhibitors • Sample Coolers • Water Testing Equipment • Zeolites

"IRON FIREMAN cut our steam costs 58%"

—says Sprague Warner-Kenny Supervising Engineer

Eugene T. Molloy, *Supervising Engineer*

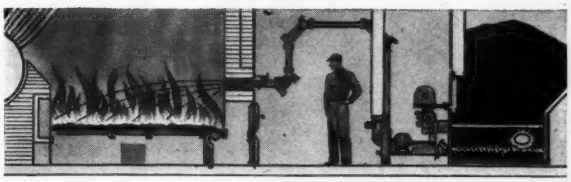
THE cost per thousand pounds of steam dropped from 62c to 26¼c, or 58%, at Sprague Warner-Kenny in Chicago when an Iron Fireman coal stoker was installed. For their food processing plant and warehouse this company installed a Pneumatic Spreader in a 400 h. p. Lasker Water Tube boiler.

This Iron Fireman Pneumatic Spreader installation replaced oil firing, and will reduce annual fuel costs from $21,266 to $8,551, resulting in a savings of $12,714 a year.

In addition, says Mr. Molloy, "With Iron Fireman our steam pressure remains more constant under loads which vary from 75 h. p. in summer to 800 h. p. in winter. Besides the saving in fuel Iron Fireman has saved us about $500 a month in labor costs."

Iron Fireman Stokers are Available . . . See what they can do for you

In the interest of fuel conservation, and your own plant efficiency—as well as labor savings and money savings—find out what Iron Fireman can do for you. Because their performance contributes so greatly to the nation's war economy, Iron Fireman commercial and industrial stokers are in full wartime production. Our nationwide organization of qualified factory representatives and dealers is at your service. For free survey, write or wire the Iron Fireman Manufacturing Company, 3291 West 106th Street, Cleveland 11, Ohio.



The Pneumatic Spreader conveys coal in an overhead pipe from the bunker to the fire. By means of an adjustable nozzle, the coal is dropped by gravity and distributed uniformly over the entire grate surface. Sizes now available for firing commercial and power boilers up to 1000 h.p. and larger.

IRON FIREMAN

THE IRON FIREMAN

AUTOMATIC COAL STOKERS

Yarway Impulse Traps

For Pressures Up to 1500 lbs

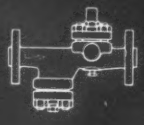


Fig. No. 140 to 147. Medium pressure integral-strainer impulse Trap for pressures up to 600 lb. Steel body, flanged connections.

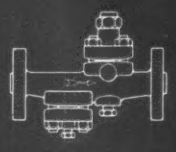


Fig. No. 150 to 157. Super-pressure integral-strainer impulse Trap for pressures up to 1500 lb. Steel body, flanged connections.

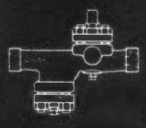


Fig. No. 250 to 257. Medium pressure integral-strainer impulse Trap for pressures up to 600 lb. Steel body, socket weld connections.

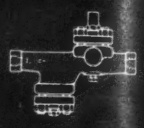
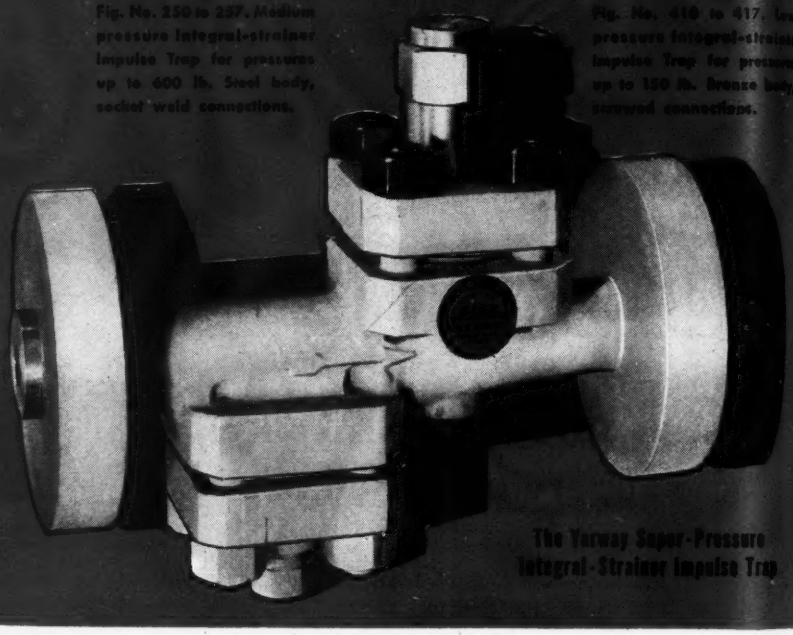
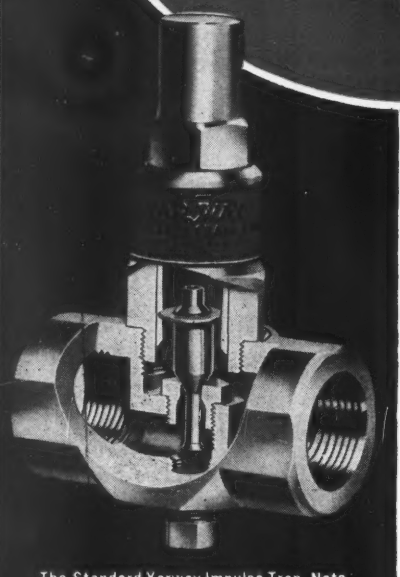


Fig. No. 410 to 417. Low pressure integral-strainer impulse Trap for pressures up to 150 lb. Bronze body, screwed connections.



The Yarway Super-Pressure Integral-Strainer Impulse Trap



The Standard Yarway Impulse Trap. Note only one moving part — a little valve.

ALONG with the remarkable success of the YARWAY IMPULSE TRAP for standard trapping service (more than 250,000 have been purchased), has come its use in steam plants where pressures as high as 1500 lbs and temperatures as great as 900°F are encountered.

The integral-strainer trap shown above, developed for this service is suitable for every drainage requirement in high pressure steam installations. It has ample condensate capacity when system is being "warmed up". It will handle relatively small amounts of high temperature condensate, efficiently, without losing its prime.

The valve closes positively in the presence of dry or superheated steam.

It is a fraction of the size and weight of other type traps designed for the same service—saving space, simplifying installation and requiring no support.

It is suitable for all pressures within a wide range without change of valve or seat.

It has the same simplicity of design as does the standard Impulse Trap—only one moving part, a little valve.

Its integral-strainer protects the trap against scale and rust in the system.

For complete description of operating principle, send for Bulletin T-1738.

YARNALL-WARING COMPANY, 114 MERMAID AVE., PHILADELPHIA 18, PA.

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

The Power of American Research

By HOWARD E. FRITZ

RESEARCH is the greatest constructive and destructive power that mankind possesses and controls, bar nothing.

This destructive power of research is very real. There is no menace which can be as deadly to an established business as industrial research. No war, no panic, no bank failure, no strike, no fire can so completely and irrevocably destroy a business as a new and better product in the hands of a competitor.

The following statistics were gathered from F. R. Bichowsky's book on "Industrial Research":

"In 1850 there were over 2500 miles of canals completed or under construction in the United States. Nearly a thousand additional miles were projected. . . . Over 150 million dollars had already been invested in this business. In terms of national wealth, this presented a proportionate investment equal to an expenditure of 7 billion dollars at the present time . . ."

"In 1860 the canal was dying . . . The total loss to the states . . . was over a quarter of a billion dollars . . . The indirect loss was surely much greater as the default of the canal bonds was one of the causes of the panic of 1856."

The railroads came and prospered, and in 1910 "the railroad executives who never learn anything sat back and said, 'Now we have a perfectly safe business. No outside competition can touch us; all we have to do is to sell more bonds, build more railroads, collect more profits. There can be no competition to a railroad except another railroad; the experience of the canals proved that' . . ."

In 1910 the market value of the stock of all American railroads was 8.3 billions and the value of the bonds about 12 billions.

Now, of course, in 1910 our railroad executive was aware that some "crackpot" mechanics, out in the Middle West, had invented a gadget called the automobile. But to imagine that these monstrosities would ever compete with the Pullman car was as absurd as that fool report that two bicycle repairmen out in Dayton had learned how to fly.

Yet in 1940 . . . the market value of the railroad bonds was less than 8 billions, and our railroad executives . . . could have bought on the open market the complete stock ownership of the American railroads for 2.2 billions of dollars.

This technological loss is directly chargeable to the research laboratory, or, more fairly, to the management which failed to insure against this loss. You know the history of the candle and kerosene oil lamp. Likewise you know the history of the carbon filament lamp which replaced them.

This is a law of research: "Every new product produces wealth greater than it destroys," for the human need or desire which made it possible for the new to displace the old gives to the new a greater market than the old ever enjoyed.

Industrial research activity in these United States between 1920 and 1940 increased by approximately 700 per cent. In 1920 there existed approximately 300 industrial research laboratories. In 1940 there were more than 2200 such laboratories employing 70,000 people and spending approximately $300,000,000 annually. What is all this for? Just a search for new knowledge, from which new knowledge we hope for still further advance in our social life and comforts. But research, possessing such powerfully destructive potentialities, must be carefully and patiently exploited to avoid grave tragedies and blunders.

When World War II is behind us, we are going to publicly awaken to the importance and value of another group of scientists, who, under censorship, are playing such a vital role in our military effort. I refer to the physicists. These folks will write the rules for use in maintenance of intricate electronic and magnetic devices, just as the chemist wrote the rules for plastics such as Nylon, and Saran, ethyl gasoline, Koroseal, Neoprene, and the new and life-saving sulfa drugs, hormones, vitamins, insulin and penicillin.

In the past, new things have been viewed with suspicion, the masses have been loath to experiment, but as a result of wars, economic upheavals and depressions, appreciation of the indispensable character of fundamental research is constantly increasing in government, industry and with the general public.

The investor, more now than ever before, is looking to research as his measuring stick for guidance. We are all hurrying to put this war behind us, and in due course we shall return to our conquest of nature for the benefit rather than the destruction of mankind. We shall then fully utilize the dynamic force of this great power, American research.

Here are some of the things we may expect:

1. Aluminum, once a rare metal, in fantastic volume at low prices.

2. Magnesium at one-fifth the weight of steel from an inexhaustible source, the sea.

3. Triptane, which is trimethyl butane; 150 octane motor fuel; a "designed" molecule.

4. Thousands of low cost abundant raw materials from petroleum, unknown commercially before.

5. A cloth-like material which needs no weaving, from mixtures of natural and synthetic fibers, by the use of paper-making technique.

6. Non-shatterable glass and glass fibers with tensile strength ten times that of mild steel.

7. A chemical which provides a sort of invisible raincoat for anything that is dipped in it. Yet our microscopes reveal no film upon the substance so treated.

8. New rubber, not as we have known it heretofore, but hundreds of rubbers and materials with rubber-like properties, performing unique and unexpected jobs and made from wheat, corn, garbage, soybeans, coal, petroleum, limestone, milk, sweet potatoes and salt.

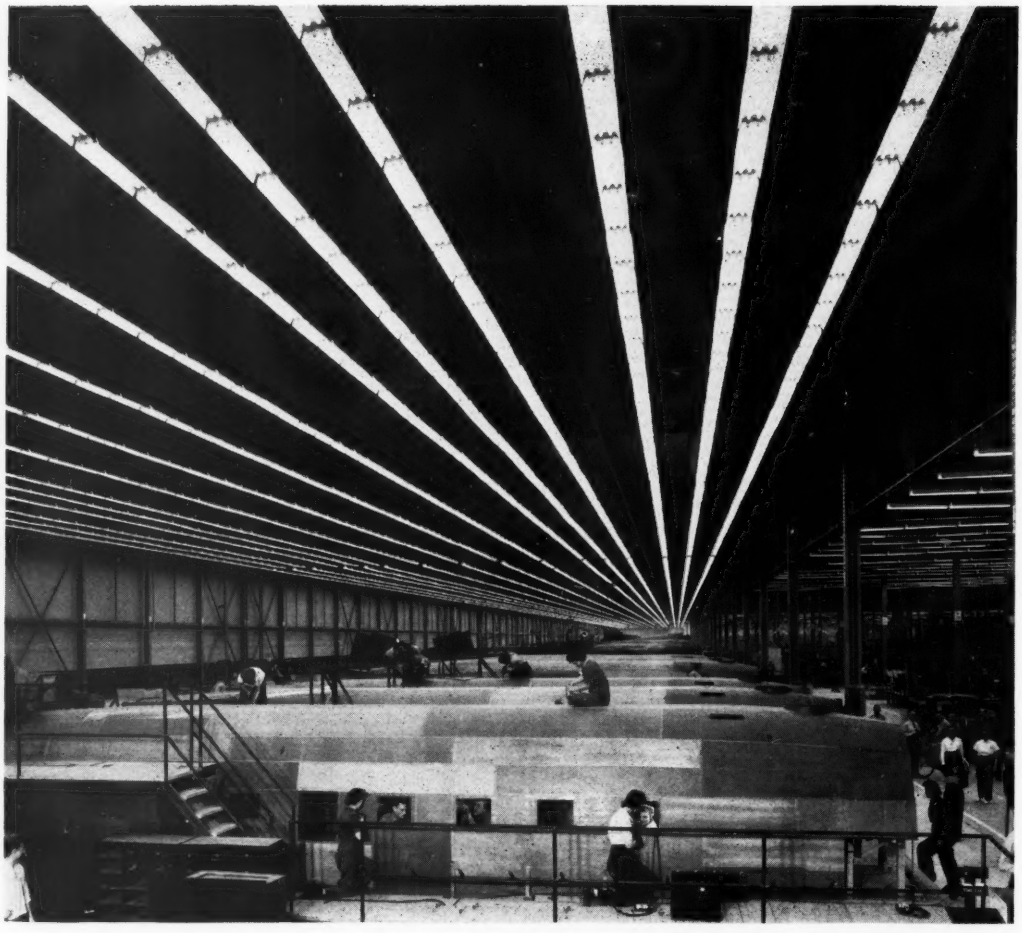
9. Germ-killing chemicals, new anesthetics, synthetic vitamins and medicines prolonging and saving man's life under the new hazards and conditions.

10. Electronics and the electron, including television, frequency modulation and the electric eye.

This war has wrought profound changes on ourselves and our environment. The guns and planes have modified or leveled the skylines of such great cities as London, Rotterdam, Stalingrad, Naples, Leningrad. The production effort has likewise leveled the spires and pinnacles of modern research and development—there is very little if any private technical know-how any more—everybody knows what everybody else is doing; the technology of industry is an open book for the benefit of final victory. This is entirely as it should be, for we have succeeded collectively where we might have failed individually, and it only demonstrates the flexibility of the workings of a democratic order.

But if we are willing to work and use all of the tools we have, we can come near to carving out any kind of a future that mankind can conceive.

Dr. Howard E. Fritz, director of research, The B. F. Goodrich Co., was born in New Portage, Ohio, now the City of Barberton. He was graduated at the Ohio State University in 1914, as a B.S. in chemical engineering, received his doctor's degree in 1921 and served on the engineering school faculty of that institution. He joined The B. F. Goodrich Co. in 1925 as manager of a small department for bonding rubber to metal by a special process. In 1934 he assumed direction of the development and sale of Koroseal. Now, as director of research, he is responsible for one of the largest technical and laboratory groups in the rubber industry. The above material was taken from his recent address under the same title before the Technology Club of Syracuse, N. Y.



Continuous Troffer Lighting

New developments bring new terminologies. During the past five years we have added many new words to our vocabularies, words which had no significance prior to 1939. We have come to know the meaning of such terms as, flak, ack-ack, fox hole, blockbuster, etc., even though we, on this side of the world have had no first hand experience with any of these things. Each war, it seems, brings forth its own peculiar terminology. The last war gave us camouflage, ashcan (for depth charge), tank and many other terms which are in common use in this war. The home front and the industrial field also develop new terms. In the photograph shown here, is a fine example of what has come to be known as "troffer" lighting—specifically, continuous fluorescent troffer lighting. "Troffer" is a new term in lighting and derives from the trough like fixtures employed. This striking picture is a view in the great Oklahoma City plant of the Douglas Aircraft Co., Inc., the boiler plant of which is described on page 80 of this issue. Continuous fluorescent troffer lighting units with non-metallic reflectors were installed throughout the plant with 4-lamp instead of 2-lamp ballasts, with a resulting saving of some 200 tons of critical metals. Sixteen rows of continuous fixtures extend the full length of the plant in the main assembly area, where a uniform level of illumination is maintained at 55 ft candle intensity. Floors of white cement provide light reflection to aid men and women working on the underside of wings and fuselages, while the interior walls are painted a light green to maintain the color of spring foliage the year 'round. The ceilings are white fiberglass that absorbs factory noises and reflects light. The plant was designed by The Austin Company and started producing C-47 Skytrains in less than a year from the time the ground for this enormous manufacturing plant was first broken

WITH THE EDITORS

◆ **$60,000 AIN'T HAY**—One of the things that never fails to depress us in our visits to power plants around the country is the deplorable waste that goes on in so many small industrial power plants. Looked upon as a necessary evil by the owners, the small industrial power plant is given scant attention and the tendency seems to be to spend as little as possible on it and still keep it running.

Once in a while, however, we get a real lift by running into a really modern small plant where everything is done as we think it should be done. This happened recently when we came across a plant serving a medium size paper mill, a sweet little number consisting of a single 600 psi boiler and a single turbine generator. This plant, we discovered, had replaced an old plant consisting of three old, 150 psi boilers and an engine, and was effecting a saving of some $60,000 a year in the overall production costs. Now, $60,000 a year ain't hay no matter how one looks at it, and it seems to us that if such savings can be made in one plant, they can be duplicated in other similar plants. It can be assumed of course, that in this particular case, the old plant was hopelessly inefficient, but there are many such plants.

At the present time, when industrial plants have been operating at top capacity with old and largely worn out equipment for four years or more, many plant owners and engineers will admit that their power plants could be improved but that there is nothing they can do about it now. Even if they could buy equipment, they have manpower shortages and are unable to do any planning. Many of the operating engineers have vague plans for improving their plants in the post-war period but, just now, they cannot spend the time it would take to make a thorough analysis and draw up definite plans.

All this is quite true but there is a simple and effective way out for the owners of such plants if they will only take it. That is, to employ outside help—outside consulting and contracting service. With the construction of the large war plants slowing up, many of the consulting engineers and contractors who have been engaged in designing and building these war plants are finding themselves with time on their hands and they are looking around for things to do. These engineers are trained and experienced in the business of finding ways to save money and they are in a position, now, where they can make investigations and submit reports. Now is the time for plant owners and operators to avail themselves of their services.

◆ **TRANSITIONAL REHABILITATION**—There is much talk about post-war planning and with it much confused thinking on the subject. It is desirable and necessary to look ahead, of course, but what is more needed than post-war planning at this time is attention to what can be done between now and the day peace is declared. The term transitional rehabilitation has been used in this connection and it is a very appropriate one.

What happens to our national economy when the war finally ends will depend to a large extent upon how ready American manufacturing plants will be to produce civilian goods. If they are ready the day peace is declared to start producing civilian goods, there need be little need for worry about unemployment. If, through their contacts with jobbers and retail outlets, they can decide in advance what kind of products will be most needed and if in the meantime they have arranged their manufacturing facilities and material stocks to immediately produce these products, they will be able to keep their plants running. The manufacturer who makes such plans and who has his plant ready to begin "civilian operations" on the day war ends will have the edge on his competitors.

It is encouraging to know that many of the smaller manufacturers are doing work of this kind. In some instances equipment is already being assembled and collected and fairly complete factory layouts made with the aid of outside consulting service. This is the important point, the fact that this work can be done by outside agencies so that it will not affect the manpower problems of the manufacturer. There are consulting engineers all over the country capable of undertaking work of this kind at the present time. This applies to power plants as well as it does to factories. The plant referred to above, which effects a saving of some $60,000 a year was built with the aid of such outside help. This particular case involved the building of an entire new plant, something which cannot be done at the present time, perhaps, and not necessary in most instances. Despite all the conflicting rumors, as the war in Europe draws to a close as it gradually must, more and more power plant equipment will become available and even if it will not result in the streamlined post-war type of plant we see in the ads, it can be used to give good service during the transitional period. Real post-war planning is something far in the future—five, ten, even twenty years ahead perhaps. What is needed is something that will tide us over the difficult period between now and the year or two or three following the end of hostilities.

◆ **PREDATORY COMPETITION**—There is another factor in this conversion to peacetime production that bears watching and this is what may be called predatory competition. This concerns the new factories—factories that did not exist before the war but which were built specifically for war production. There are quite a large number of such plants throughout the country, and while some of them may be scrapped or pass out of the picture in other ways, others will continue to operate after the war. These factories, of course, have never made civilian goods but their owners intend to get into some line of civilian goods production as soon as they can. In some instances plans are being made by the owners of such plants to manufacture certain peacetime products for only a short time, for only two years following the close of the war. In short, the owners of such plants have no intention of continuing in competition with the old, established manufacturers in particular fields but they are intent on making a "killing" while the pent-up demand for goods exists. It is possible, of course, that legislation will be effected to prevent such predatory competition but unless such restraints are imposed, it can give the old, established firms many headaches.

◆ **WHAT TO DO**—It should be evident from the foregoing discussion that the companies that want to survive after the war should be doing something about it now. The company that waits, that makes no plans or fails to properly analyze its capabilities before the war ends, may find itself hopelessly handicapped when the war does end. Then it may be too late to begin rehabilitating its plants, and other companies who will have done so will get the business.

A sound attitude towards this problem of transitional rehabilitation involves three factors:

1. Plan now. Make studies of the probable demands for type of products the plant in question is capable of producing. Determine what changes in equipment and factory layout may be necessary for efficient production. Investigate markets and methods of distribution. Try to anticipate labor problems.

2. Start to put the results of these studies into effect at once. Contact machinery manufacturers and other sources of supply so that such new equipment as may be necessary may be installed as soon as it becomes available.

3. Don't try to do all of this yourself. Enlist the services of outside agencies—consulting engineers, contractors, jobbers. Your own manpower shortage will not permit you to spend the necessary time and effort on these studies but you will find that there are plenty of outside agencies capable and in a position to help you.

This last point is very important and one that many are inclined to overlook while under the stress of war production.

◆ **DEMON RUM**—A recent whisky ad in the United States News shows a beautiful colored picture of the power plant of the future drawing its energy right out of the sky from lightning flashes. The caption under the picture tells us that in the plant of tomorrow "giant vacuum tubes will attract the virtually boundless energy of electrical storms . . . transmitting it to storage plants that will furnish fantastically cheap power to industries and whole cities." "Already," so the ad says, "pilot plants are being designed that will put into practice this progress of the future." We have not been able to get any whisky lately but if the modern blends produce such cockeyed dreams as this, we are getting on the wagon at the earliest opportunity. Our advice to the boys that write the ads is that they had better lay off the stuff too.

Bayside—*Simple and Progressive in 1943*

Fig. 1. General cross-section through Unit No. 3 installed in 1943 at Bayside Station, showing general arrangement of single turbine-generator and boiler and principal auxiliaries

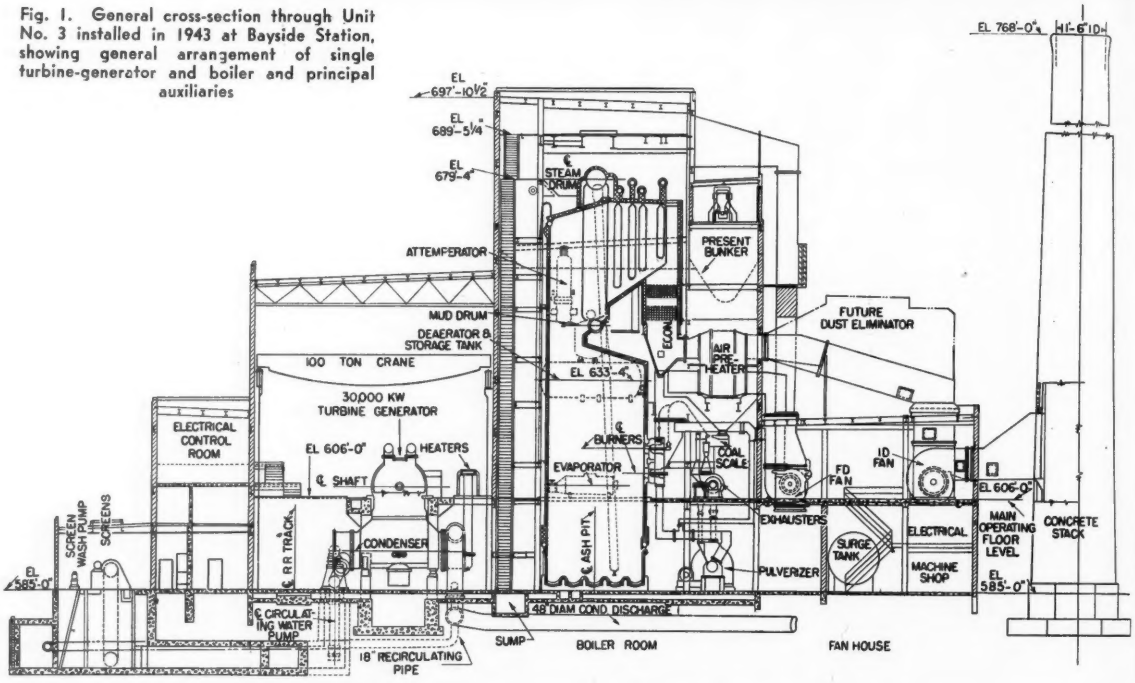


Table I—Features of Bayside in 1943—Related to 1927 Features

1—SAME DESIGN FOR HIGH AVAILABILITY AND EFFICIENCY over wide range, simplicity of operation.
2—ONE 30,000-KW GENERATING UNIT—3600 rpm—representative of present practice.
3—UNIT PLAN—one boiler per turbine—now common practice in field.
4—RADIANT TYPE BOILER—development of once through or single-pass idea—now widely used in central stations.
5—STEAM CONDITIONS 650 psi, 900 F—conservative pressure, upper safe temperature limit, widely used today but not extreme.
6—SIMPLE HEAT BALANCE—4-point turbine extraction—more motor driven auxiliaries—common practice.
7—FURNACE entirely of heat absorbing surface—common practice today.
8—UNIT PULVERIZERS, direct firing, mill drying—practically standard for pulverized coal plants today.
9—BURNERS—recent designs for turbulence—separate low load burners—common practice.
10—ROTARY ELEMENT TYPE AIR PREHEATER, separate fans—widely used today.
12—HYDROGEN-COOLED GENERATOR—idea developed since initial Bayside units.
13—FULL AUTOMATIC BOILER CONTROL—now common utility practice.
15—COAL HANDLING expanded as originally planned—new hydraulic ash handling system.
16—DIRECT-CONNECTED EXCITER—now common practice.
17—GENERATION at 13.2 kv—two-section ring bus installed as originally planned.
18—ELECTRICAL SYSTEM with new centralized control, electric-driven auxiliaries on double bus system based on same idea as original system.
19—MAKE-UP WATER LOW—evaporator used—considered standard practice today.

Recent Developments Incorporated in Unit No. 3

ATTEMPERATOR for steam temperature control.
LARGE DOWNCOMERS on boiler to assure good natural circulation.
MAGNETIC COUPLINGS on F.D. and I.D. fan drives for close control over wide range.
VERTICAL PROPELLER TYPE condenser circulating pumps.
CIRCULATING PUMPS of 60% and 40% full load capacity for flexibility and economy.
ONE BOILER FEED PUMP of 60% full load capacity, for part load operation.
NEW COAL DOCK and storage space, built in 1928.
REMODELED circulating water intake.
DIVIDED BUS SYSTEM for motor-driven auxiliaries with automatic throw-overs to prevent plant shut-down.
COMBUSTION EQUIPMENT INTERLOCKS for safety.
INSTRUMENTATION of plant based on thorough study, to secure essential data and operating convenience.

IN THE SPRING of 1927, one of the editors of POWER PLANT ENGINEERING was invited to visit the new Bayside Station at Green Bay to secure data for a description of the station, where the initial installation of two 10,000-kw steam turbine generator units was just being put into service. He found a power plant simple, compact, progressive in design without being freakish or experimental, designed for highest availability and efficiency over a wide load range. His description of it, emphasizing those characteristics, was published in the June 1, 1927, issue of POWER PLANT ENGINEERING.

In the autumn of 1943, a little over 16 yr later, the same editor was invited to visit Bayside again to inspect the new 30,000-kw steam turbine-generator Unit No. 3 added to the station earlier in that year. During the 16-yr interim a number of the fundamental ideas that were considered advanced in the original Bayside design have since been widely accepted in the power engineering field. Hence the editor found that they are incorporated in their modern form at Bayside, since they represent modern standard practice. But besides that, a number of the most

as in 1927

Unit No. 3 at Bayside Steam Station of Wisconsin Public Service Corp., Green Bay, Wis., backs up hydro system and meets growing war demands. It consists of a 30,000-kw turbine-generator and a 312,500-lb per hr, 650-psi 900 F steam generating unit. Features of extension compared with those of original 1927 installation. New unit reflects 16 years' progress, incorporates latest developments, is as forward-looking in 1943 as original units were in 1927

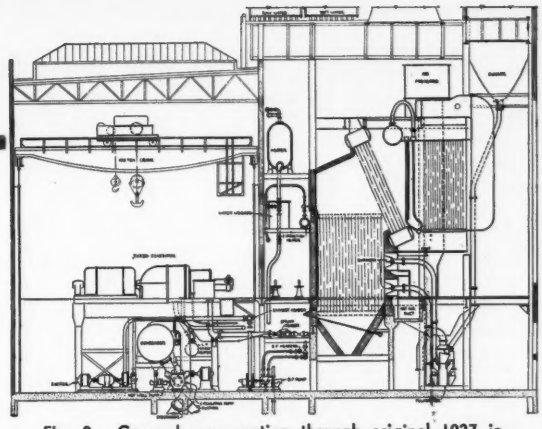


Fig. 2. General cross-section through original 1927 installation at Bayside Station, showing one of the two 10,000-kw units—approximately same scale as Fig. 1

recent developments in both steam and electrical generation have been incorporated in Bayside's 1943 unit. As a result, the station not only reflects the coming to maturity in present-day practice of its original advanced design, but also shows in the new unit a design as simple and progressive for 1943 as the original station was for 1927. The editor has tried to demonstrate this in the following description.

Operating Conditions—1927 and 1943

In 1927, Bayside Station was planned primarily to operate in conjunction with the hydroelectric plants of the Wisconsin Public Service Corp. system. That requirement remains the same today. It was found in 1940 that increasing loads on the system required additional generating capacity, no available hydro sites could be developed, purchase of firm power was not practical nor economical, hence steam capacity had to be added. Load growth studies and availability of water-borne coal indicated that this capacity should be added at Bayside.

The load on Bayside fluctuates over a wide range, depending largely on the water conditions at the various hydroelectric stations. Consequently, the need for high availability and high efficiency over the load range determined Bayside's design in both 1927 and 1943. Also, the 30,000-kw unit of 1943 is the largest single unit on the system, hence it must have high availability.

Features of 1927 Installation

The original 1927 station, to meet the above conditions, was designed with a number of features that were, in their day, not experimental but definitely advanced design. It was to operate for long periods without shut-down but no

Table II—Features of Bayside in 1927

1—DESIGN FOR HIGH AVAILABILITY AND EFFICIENCY over wide range, simplicity in operation, to back up hydro system.
2—TWO 10,000-KW GENERATING UNITS—1800 rpm—representative of good practice.
3—UNIT PLAN, one boiler per turbine—advanced practice.
4—SINGLE-PASS BOILERS—new idea.
5—STEAM CONDITIONS 350 psi 750 F—advanced but not extreme.
6—SIMPLE HEAT BALANCE—3-point turbine extraction—essential auxiliaries turbine driven—common practice at the time.
7—WATER-COOLED FURNACE WALLS—growing in favor but still advanced practice.
8—UNIT PULVERIZERS, mill drying with preheated air—just coming into general use.
9—TURBULENT BURNERS—new but based on recent research—advanced practice.
10—ROTARY ELEMENT TYPE AIR PREHEATERS, integral fans—relatively new in power plant field.
11—SPRING-SUPPORTED CONDENSERS—new idea.
12—AIR-COOLED GENERATORS—standard practice.
13—REMOTE MANUAL BOILER CONTROL.
14—AUTOMATIC SOOT BLOWERS—new idea.
15—COAL-HANDLING SYSTEM—standard at time—designed for future expansion.
16—SEPARATE EXCITERS for main units—controversial at the time.
17—GENERATION AT 13.2 KV—single bus system, designed for future double bus.
18—Electrical system with CENTRALIZED CONTROL ROOM, auxiliaries connected to two power sources.
19—MAKE-UP WATER LOW—evaporator used—common practice at time.

Fig. 3. Exterior view of Bayside Station as it appears at present, building extension and new stack for Unit No. 3 at left

spare capacity in main units was provided. Two boilers and two turbines were installed, each boiler normally serving one turbine, with cross-over header so that either boiler can supply either turbine, connected on the electrical side at the bus.

Other features of the station, most of them representing the most progressive practices of their day, are summarized in Table II, shown on Fig. 2, and detailed in the above mentioned 1927 article.

Features of Unit No. 3 in 1943

Turning now to the 1943 extension, Unit No. 3, its outstanding features, outlined in Table I, are described in detail and commented on in the remainder of this article. Compared with those of the original installation, they form a typical picture of the 16 yr of development in the field.

The unit plan of one boiler per turbine—an innovation in 1927—has now been generally accepted in the central station field and, wherever possible, in industrial plants as well. It has been carried out in Bayside's Unit No. 3 as shown. Here also is a good illustration of the way in which the unit design permits a plant to take advantage of developments in technique and equipment that can be incorporated in successive units. Unit No. 3 operates entirely independent of Unit Nos. 1 and 2, the only connection between them being at the high-voltage generator bus.

Unit No. 3 Never Shut Down

Continuity of operation is of the same importance in the new unit as in those of 16 yr before, as well as flexibility and high efficiency over the load range. In fact, the new No. 3 unit is never shut down. On week ends, when the load is light, it has been found more economical to keep the unit operating at the very low load of 5000 kw, thus keeping it hot and avoiding shut-down and warming up of turbine, boilers and all auxiliaries. The resulting low efficiency must be accepted, of course, but the saving in operating cost and trouble more than makes up for it.

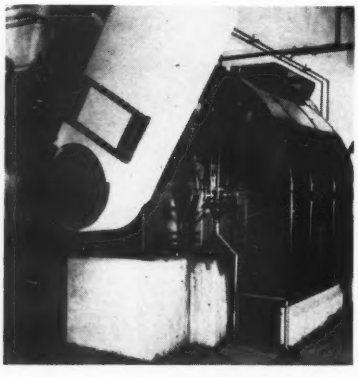


Fig. 4. View of one of the two 9.5 ton per hr rotary type pulverizing mills, showing primary air connections

For the new 1943 unit, steam pressure of 675 psig and total steam temperature of 900 F were adopted. At this temperature, close to the upper limit for present-day power plant steel, accurate control of steam temperature is imperative. This is accomplished by a method new within the past three or four years, as described below. In the original Bayside installation, no special provision for temperature control beyond the expected skill of the operators and the inherent design characteristics of the boiler was available at the time.

A number of new features in Unit No. 3, described below, show that here again advantage has been taken of the progress in design and operating technique made by the power engineering field in the 16 yr since the first units of 1927 were installed. But here again, these new features, while they have been well tested in operation in a number of plants during the past few years, are not experimental but represent typical advanced practice of the present time. In short, Bayside Unit No. 3 is just as simple, up-to-date and forward-looking in 1943 as Units Nos. 1 and 2 were in 1927.

New Steam-Generating Unit

In detail, the single steam generating unit of the 1943 installation consists of a radiant type water-tube boiler, as shown in Fig. 1, with submerged attemperator and water-cooled hopper-bottom furnace. The unit is designed to generate 312,500 lb of steam an hour at 675 psig, 900 F with feedwater at 375 F to the economizer. The furnace has a volume of 20,000 cu ft, is designed for a heat release of 21,000 Btu per cu ft per hr.

The entire boiler unit is suspended from two beams 35 ft long, the tops of which are 104 ft 4 in. above the basement floor. Total vertical movement of the bottom of the boiler due to expansion and contraction is 3½ in. It weighs about 600 tons.

To assure positive natural circulation in the boiler, a large downcomer of 17½ in. inside diam. leads from each end of the top drum, to the lower furnace water wall headers as shown dotted in Fig. 1. The connections of these downcomers into the water circuit is as shown in Fig. 6. This idea has been incorporated in a number of recent boilers of this type, with successful results.*

Control of Steam Temperature

The attemperator for controlling steam temperature is connected between sections of the superheater, as shown in Fig. 6. The attemperator is a heat-exchanger containing tubes through which steam from the first superheater section passes to the second superheater section. Outside the tubes, boiler water from the economizer circulates. A butterfly valve admits steam to the attemperator from the superheater, or bypasses it, under automatic temperature control actuated from a temperature bulb in the steam outlet header of the boiler, to maintain constant steam temperature in the header. This device has been used recently on a number of boilers and is not an experiment.

Coal and Coal Handling

Full capacity of the boiler is obtained when burning Illinois coal of 11,200 Btu per lb, commercial moisture 11.4 per cent, of which 5 per cent is surface moisture. The boiler will handle coal with ash fusing temperature of 2100 F. With the above coal, guaranteed efficiency of the boiler is 86.3 per cent at maximum output.

The coal is received by water in self-unloading ships at a new coal dock built near the plant. It is stored by packing and rolling in a large storage space a short distance from the plant. To reclaim the coal, it is loaded by crane into railroad cars and hauled to the track hopper of the existing conveying system. The existing belt conveyor feeding the overhead bunkers of the initial plant was extended and since it had been operating at reduced speed, this speed was increased, giving the required capacity for the enlarged plant.

If another generating unit is added to the plant (the third extension, Unit No. 4, has been planned but held up by war conditions) the new boiler unit will be so close to the coal storage yard that an entirely new or greatly re-

*See POWER PLANT ENGINEERING, February 1944, page 124, Natural Circulation in 2500-psi Twin Branch Boiler, by Rowand and Allardice.

modeled coal handling system, delivering coal right from storage to the plant, will be required.

For the new boiler of Unit No. 3, two steel coal silos, gunite lined, of 200 ton capacity each, were built over the firing aisle. The belt conveyor system loads these silos, whence the coal flows to continuous-belt-type weighing machines and thence to the pulverizer feeders, which are of the plate and knife type.

Combustion Equipment, Unit No. 3

The pulverizers, on the ground floor, consist of two rotary type ball mills, each of 9.5 ton per hour capacity, driven at 21 rpm by 200 hp motors. One of these is shown in Fig. 4. Exhausters on the boiler operating floor draw the coal and air mixture from these mills and feed it to four inter-tube burners set in the furnace front wall. These burners have low capacity nozzles for light load operation.

Ash from the hopper bottom furnace is removed by an hydraulic ash sluice, connected to that under the existing Units Nos. 1 and 2 boilers, so that it now serves the entire plant. It discharges to a discharge pit outside the plant.

Combustion air is supplied by a single 100,000-cfm forced-draft fan, Fig. 1, capable of 15 in. H_2O pressure, driven by a 400-hp constant speed motor through a magnetic coupling. The single induced-draft fan, Fig. 1, has a capacity of

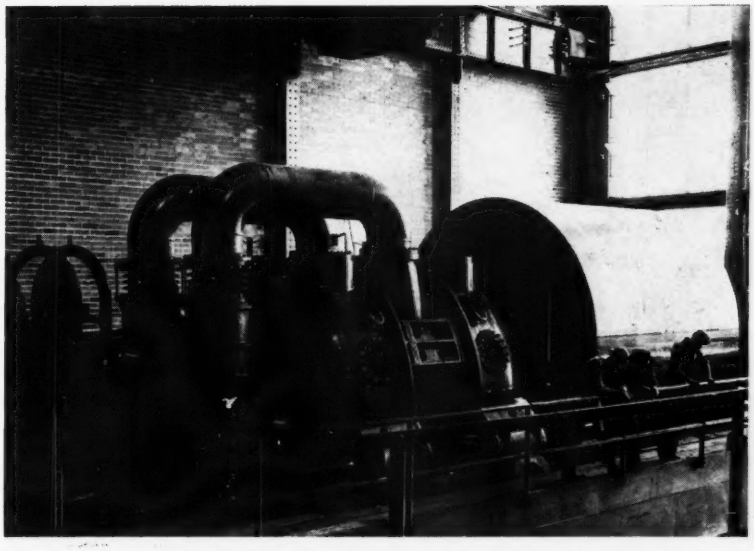


Fig. 5. View of Bayside Unit No. 3, tandem-compound 30,000-kw turbine-generator during installation, before turbine casing was in place

200,000 cfm of combustion gases at 14 in. H_2O maximum pressure and is similarly driven by a 700-hp constant speed motor through a magnetic coupling. Speeds of both fans are controlled by the automatic combustion control system, which operates the coupling exciter rheostats.

The air preheater supplies preheated primary or coal-carrying air to the pulverizing mills. A tempering air duct leading from the top of the air duct just ahead of the air preheater supplies tempering air to the mills for good mill drying at low loads. To save steel, a new concrete stack was built to serve Unit No. 3, as shown on the drawings. The air preheater for Unit No. 3 is of the rotary element type, employing the same principle as that of the original 1927 units. For Unit No. 3, however, a horizontal shaft unit is installed and separate forced and induced draft fans are employed. It is driven at 2½ rpm by a 5-hp motor.

Control of the pulverizing mill feeders is by air pressure. When the mill coal level varies, obstructing or clearing the ends of two air pressure pipes leading into the mill, it produces an air pressure

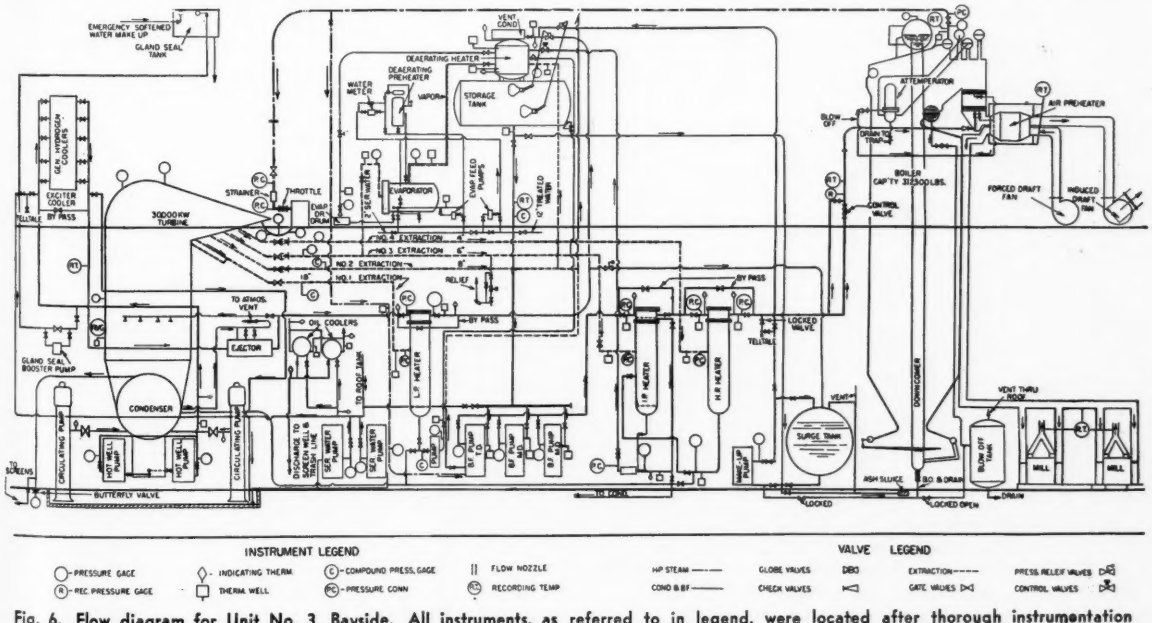


Fig. 6. Flow diagram for Unit No. 3, Bayside. All instruments, as referred to in legend, were located after thorough instrumentation study, to give complete data for operating guidance and cost accounting and for convenience and simplicity in operation

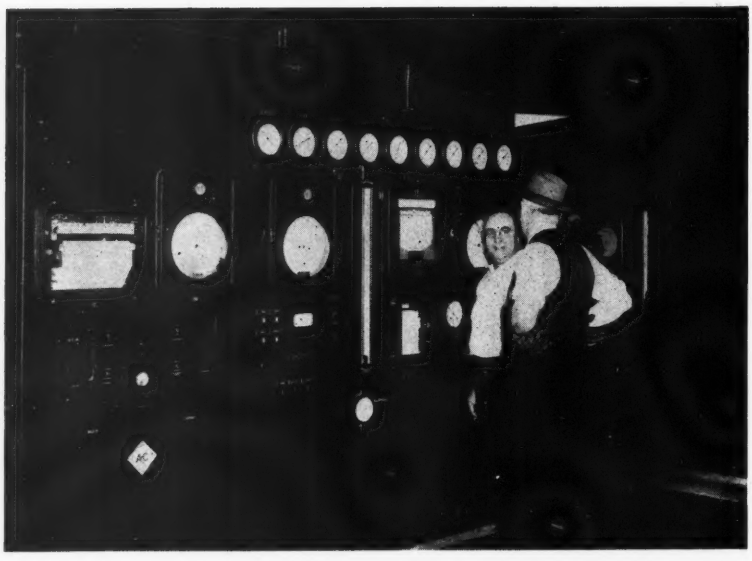


Fig. 7. Bayside's Chief Engineer M. F. Brooks, facing camera, and F. Kranenberg standing before the turbine control panel of Unit No. 3

change that actuates the control mechanism of the knife and plate type feeder, varying the amount of coal fed to the mill and maintaining the coal level in the mill between the required limits.

Combustion Safety Precautions

To minimize operating troubles by preventing any coal from entering the boiler furnace in case air supply and draft should fail for any reason, driving motors of the fuel and air supply equipment are interlocked to start in this order: 1, draft fan; 2, forced draft fan; 3, pulverizer exhausters; 4, pulverizer driving motor; 5, pulverizer feeder motor. No unit can start unless the unit ahead of it, in that order, is operating. Interlocking is initiated from the circuits of the magnetic couplings on the fans rather than from the a-c power of the fan motors. If the induced draft fan fails, the interlock shuts down the motors in the reverse order. If the pulverizer exhauster fails, the pulverizer and feeder motors shut down, but the induced and forced draft fans remain in service.

A purge interlock is installed in such a way that the pulverizer, feeder and exhauster motors cannot be started until the forced and induced draft fans have been started and air has passed through the boiler for a definite length of time.

Turbine-Generator No. 3

The new turbine-generator, Unit No. 3, consists of a tandem-compound reaction type turbine driving a hydrogen-cooled generator with direct-connected main and pilot exciters. The unit is rated at 30,000 kw, 84 per cent power factor, 3600 rpm and generates at 13,800 v, 60 cycles, 3 phase.

The turbine is furnished with four bleed points for supplying steam to extraction feedwater heaters and evaporator, as shown on Fig. 6.

The generator hydrogen cooling system circulates 1600 cu ft of hydrogen at 60,000 cfm and is capable of absorbing 1,670,000 Btu per hour. Scavenging is by the vacuum method. Lead diaphragm type explosion doors are used in the low-pressure casing instead of relief valves. This eliminates piping and is reliable. Hydrogen cooling of generators is, of course, a development entirely new in the power plant field since the original 1927 installation at Bayside.

On this generating unit, the overspeed trip on the turbine actuates a trip coil on the generator breaker. This is done to prevent the hydroelectric turbines on the system from carrying the steam turbine generator to breakdown speed. The hydro units will stand considerable overspeed and the gates on the hydro units are slower in action than the steam turbine valve mechanism. Thus the hydro units might cause the steam unit to overspeed if the latter were left connected to the circuit.

Condenser and Vertical Circulating Pumps

The turbine exhausts to a single-pass 15,000-sq ft surface condenser. This is of conventional present-day design and although some of the construction details are different from those of Units Nos. 1 and 2, they cannot be described here. This Unit No. 3 condenser has 3030 admiralty metal tubes installed in a shell 9 ft in diameter by 32 ft long. Tubes are

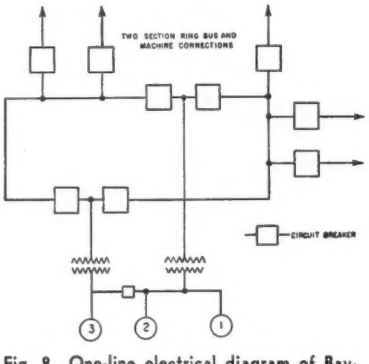


Fig. 8. One-line electrical diagram of Bayside two-section ring bus and machine connections

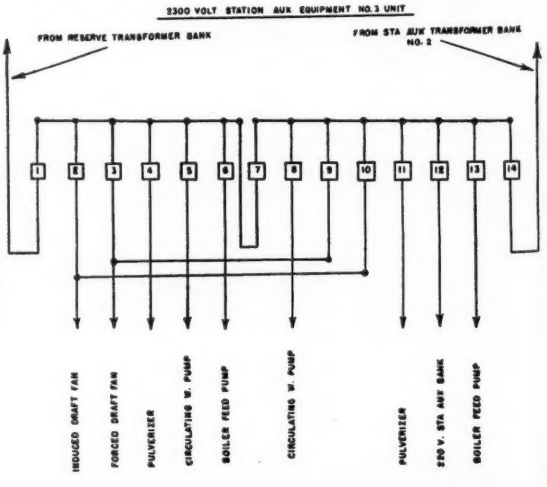


Fig. 9. One-line diagram of electrical circuits serving 2300-v auxiliaries. This is a double-bus system, each bus supplied from separate energy sources, vital auxiliaries divided so that trouble on one bus cannot shut station down

rolled and flared at the inlet, rolled at the outlet. An expansion-joint is inserted in the steel shell.

The principal feature of interest in the condenser installation is the use of two vertical, propeller-type, motor-driven condenser circulating water pumps, another recent development in power station design. One of these pumps has a capacity of 21,600 gpm or 60 per cent of total required water capacity; the other has a capacity of 14,400 gpm or 40 per cent of total capacity. The total capacity of the two, 36,000 gpm, is equal to 52,000,000 gal per 24 hr.

The different pump capacities were chosen to take advantage of the improved pumping efficiency of the units at part load requirements, giving great flexibility over the entire load range of the station. It also compensates for the colder condenser circulating water in winter, when less water is required to produce the required vacuum.

Air is removed from the condensate by steam-jet vacuum pumps with a total capacity of 5 cfm. Three sets of 2-stage nozzles are installed, arranged so that any combination of primary and secondary jets can be used. Two hot well pumps have a total capacity of 500 gpm at 200 ft head.

Condensate and Boiler Feed Pumps

Condensate from the condenser flows through the generator hydrogen coolers to the vacuum pumps, then through a closed low-pressure extraction heater, Fig. 6, and thence to the deaerating heater. This unit has a capacity of 400,000 lb per hr and is designed to maintain oxygen at 0.0300 ml per liter measured by the standard Winkler test. From this heater, the condensate flows to one of the three centrifugal boiler feed pumps.

Two of these boiler feed pumps are driven by constant-speed motors, the third is turbine-driven. The steam-driven pump and one of the motor-driven pumps each have a capacity of 825 gpm at 2280 ft head, 275 F. This capacity permits either pump alone to carry full load on the boiler. The third pump is designed for a capacity of 550 gpm at 2280 ft head, 275 F, and is driven by a 500-hp motor. It is designed to handle 60 per cent of rated boiler capacity. It feeds the boiler at low loads to give high pumping efficiency and save pumping power, the larger pumps being shut down.

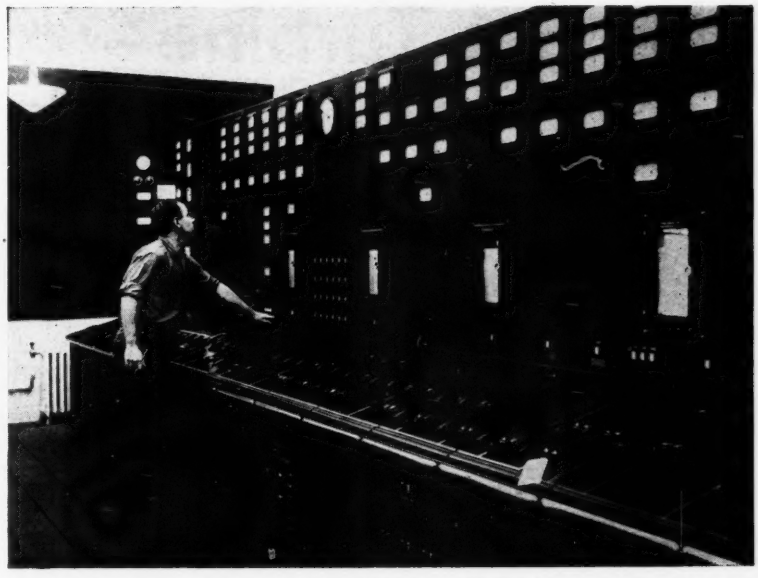


Fig. 10. View of completely new station electrical control board installed at Bayside during erection of Unit No. 3, showing Station Operator Almon Ives performing a switching operation

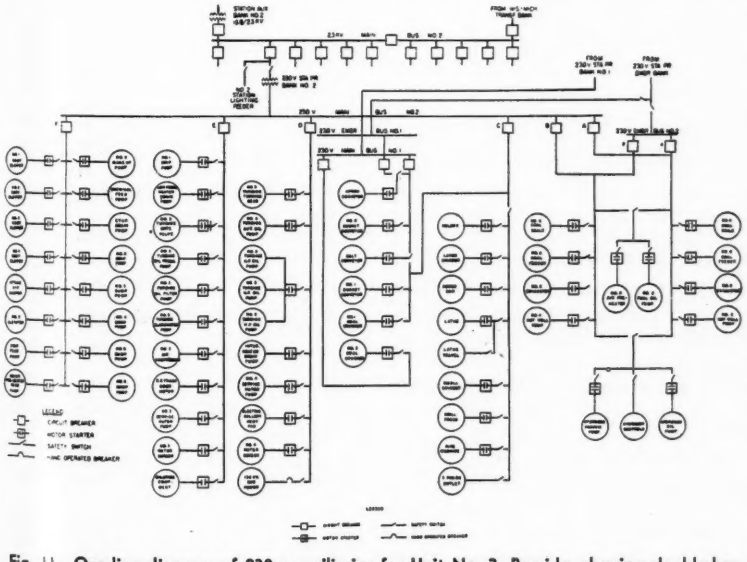


Fig. 11. One-line diagram of 230-v auxiliaries for Unit No. 3, Bayside, showing double-bus system for supplying auxiliaries with power from two sources

Water Treatment

Make-up water is very small in amount. Limits of water analysis are set as follows:

Dissolved solids	Less than 20 pp 100,000
Phosphate as PO_4	1 to 3 pp 100,000
Sulphite as Na_2SO_3	2 to 3 pp 100,000
Hydrogen as NaOH	2 to 5 pp 100,000
Silica as SiO_2	$<$ 1.6 pp 100,000
Embrittlement ratio	2.5
pH	10.9 to 11.1
Dissolved O_2	$<$ 0.03 ml per liter
Suspended matter	minimum

To maintain these conditions, chemicals consisting of the various sodium phosphates, sodium sulfate, sodium hydroxide and sodium sulfite are fed direct to the boiler drum by a chemical feed pump. The dosage is relatively small because of the small amount of make-up. The economizer is not protected except by the high pH of the feedwater.

The condensate surge tank, Figs. 1 and 6, will hold any spill-over from evaporator and deaerating heater; also, the entire contents of the boiler can be dumped into this tank.

The condenser water intake for the 1927 units had been designed, like the coal-conveying system, for future expansion. Hence in installing Unit No. 3, it

(*Continued on Page* 116)

The Gas Turbine—

Present Status and Immediate Prospects

By

C. Richard Soderberg

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and

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Director of Research and Development, Elliott Company

Gas turbine prime mover not a Utopian dream but now worthy of development . . . With 1200 F operating temperature and reheat cycle, Bunker C fuel consumption of 0.45 lb per hp-hr and weight less than 25 lb per hp seem possible with present materials . . . Capacities up to 7500 hp . . . Analysis of several cycles shows thermal efficiencies of 28 to 35 per cent at 1200 F, higher if 1500-deg materials become available . . . Data on regenerator surface, part load performance, compressors, metals, weights, sizes and fuel costs possible now and to be expected in the future

RECENT IMPROVEMENTS in the character of the gas turbine cycle make it appear feasible now to build self-sustaining power units that are independent of a separate source of compressed air and whose operating efficiencies will approach closely those of the best Diesel engines.

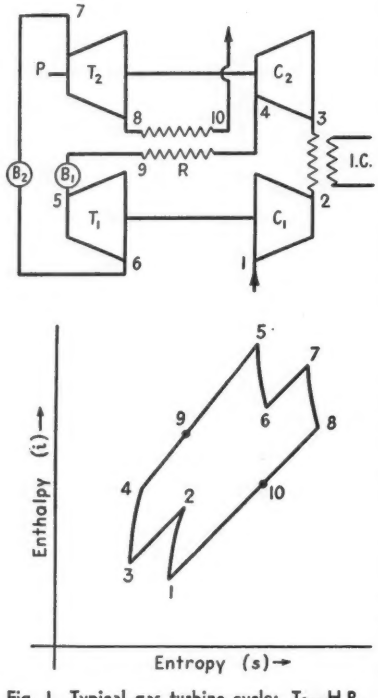


Fig. 1. Typical gas turbine cycle: T_1—H.P. turbine; T_2—L.P. turbine; C_1—L.P. compressor; C_2—H.P. compressor; I.C.—intercooler; B_1—H.P. combustion chamber; B_2—L.P. combustion chamber; R—regenerator; P—power output to generator

Power engineers are familiar with the application of multi-stage feedwater heaters in steam plants that took place in the middle 20's and led to decreases in station heat rates from about 20,000 Btu per kwhr to 14,000 Btu per kwhr without material changes in steam pressure or temperature. Just as this development of the regenerative feed heating cycle for steam power plants led to a 25 per cent improvement in steam plant heat rates, so the thermodynamic improvements currently being made in the gas turbine cycle indicate a possible improvement of 50 per cent or better in thermal efficiency without exceeding a maximum working temperature of 1200 F.

By the simple expedient of reheating between expansions, intercooling between compressions, combined with exhaust heat regeneration, gas turbines can now be designed which will be competitive with other modern prime movers.

As a background against which the gas turbine must be judged, we find the better steam plants operating at overall thermal efficiencies of 25 to 30 per cent. Somewhat better economy, from 30 to 33 per cent, has been attained in Diesel installations, but usually with an expensive fuel. While these efficiencies do not represent the last word from such prime movers, they are the result of many years of development, with the point of diminishing economic return already in sight.

Thermodynamic Aspects of Gas Turbine Plants

The combination of compressors and turbines in a gas turbine plant permit of a variety of arrangement, but Fig. 1 is representative in that it contains all the basic elements, to which the mere addition or subtraction of stages of reheating or intercooling will give a series of cycles all of which are covered by the following analysis.

The useful power in Fig. 1 is delivered by the low-pressure turbine shaft to which the high-pressure compressor is also connected. This happens to be an arrangement that is desirable for part-load performance but in all other respects the results of the analysis are equally valid when all the turbines and all the compressors are placed on the same shaft.

The Mollier chart of Fig. 1 defines the conditions at each point of the cycle. It is assumed that the quantity of gas flowing through the circuit is the same at all points (in other words that the addition to the mass flow by the injection of fuel and the reduction in mass flow by leakage are negligible) and that the thermodynamic characteristics of the gas are not altered by the

This article, written especially for POWER PLANT ENGINEERING, is based on data given by the authors in a recent paper before the Society of Naval Architects and Marine Engineers, to which they are indebted for permission to reproduce the diagrams and graphs.

chemical change which occurs when fuel is burned (in other words, that the existence of oxygen available for combustion is so great that it may be considered as infinite).

Three Factors in Performance

In analyzing the performance of the various gas turbine cycles, then, it is necessary to take into account three factors:

(1) The efficiency; (2) the air rate, and (3) the work ratio.

The efficiency of the cycle, denoted by η determines the effectiveness with which heat is used and is defined as the ratio of net power output from the prime mover over the external heat supplied to the combustion chambers.

The air rate, denoted by ω and expressed in pounds per hp per hour, is analogous to the steam rate of a conventional turbine plant and represents the quantity of fluid per unit of power output.

The work ratio, denoted by α, represents the proportion of total installed turbine power usefully delivered to the shaft. A plant operating with a work ratio of 0.4 develops 400 hp for each 1000 hp of installed turbine capacity, the remaining 600 hp being used to supply compression and to overcome parasitic losses.

The air rate, by its measure of the amount of air required, and the work ratio, by its measure of the amount of power required, are useful in judging the amount of equipment necessary for the plant as a whole. In an economic survey of the gas turbine, the ideal would be high efficiency, low air rate and high work ratio.

Performance of Several Cycles

These three quantities have been determined for a number of cycles operating at turbine inlet temperatures of 1200, 1350 and 1500 F. The results, given as a function of the overall ratio of compression and the efficiency of regeneration η_R, are shown in Figs. 2 to 10.

The regenerator, which recovers the energy in the turbine exhaust may be designed with any desired degree of effectiveness. The range will cover the extremes defined by 100 per cent regeneration—at which the temperature of the incoming air is raised to the full gas exhaust temperature (for instance, to a temperature of point 8 in Fig. 1) and by 0 per cent in which no energy transfer at all is attempted.

In computing the data represented in Figs. 2 to 10, the variation of specific heat of air with temperature was based on the most recent spectographic results. The

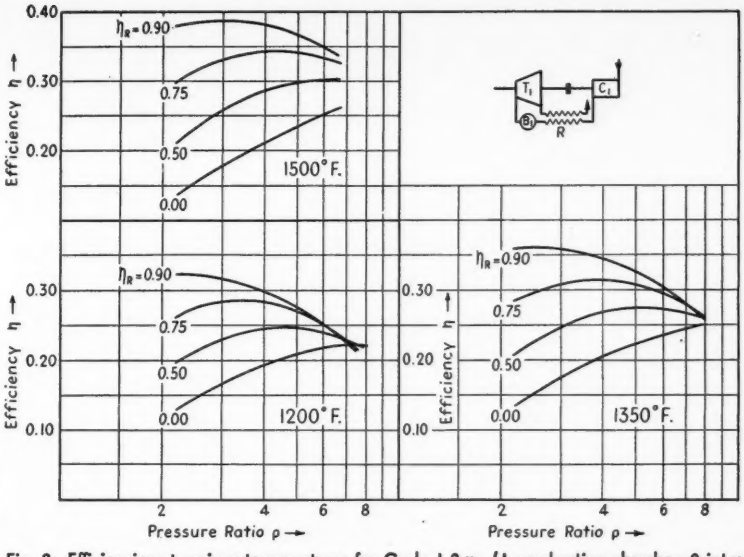


Fig. 2. Efficiencies at various temperatures for Cycle 1-0-η_R (1 combustion chamber, 0 intercoolers, various regenerator efficiencies as shown, denoted by η_R)

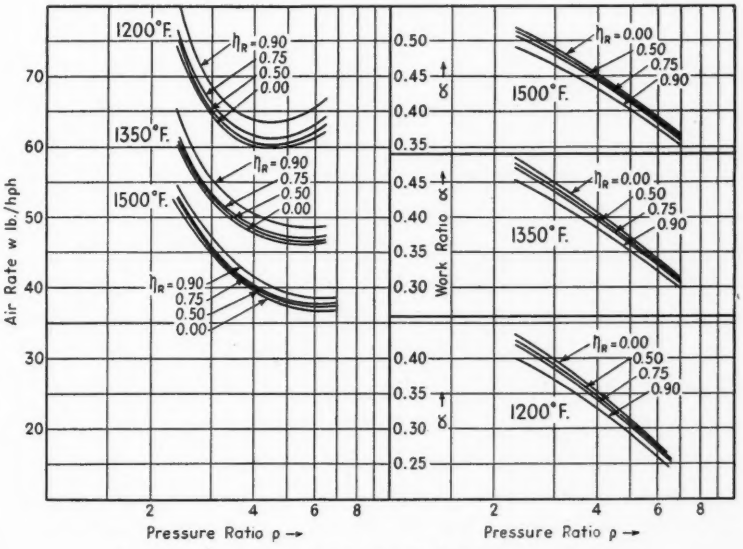


Fig. 3. Air rate and work ratios for Cycle 1-0-η_R shown in Fig. 2

basic efficiency of the various elements were assumed as follows:

These assumptions may appear to be unduly optimistic, and it is

Mechanical efficiencies	$\eta_{MC} = \eta_{MT} = 0.98$
Boiler Efficiency	$\eta_B = 0.98$
Internal turbine efficiency	$\eta_T = 0.908$
Internal compressor efficiency	$\eta_C = 0.847$
Reheat to initial turbine temperature	
Inlet air temperature	70 F
Temperature at the intercooler discharge	90 F

The parasitic losses due to pressure drops, radiation, etc., were assumed to be:

Combustion chamber	0.54 Btu per lb each
Intercoolers	0.37 Btu per lb each
Regenerators	0.55 Btu per lb for $\eta_R = 0.50$
	1.10 Btu per lb for $\eta_R = 0.75$
	2.75 Btu per lb for $\eta_R = 0.90$
Piping	0.60 Btu per lb for no reheating
	0.80 Btu per lb for one reheat
	1.00 Btu per lb for two reheats

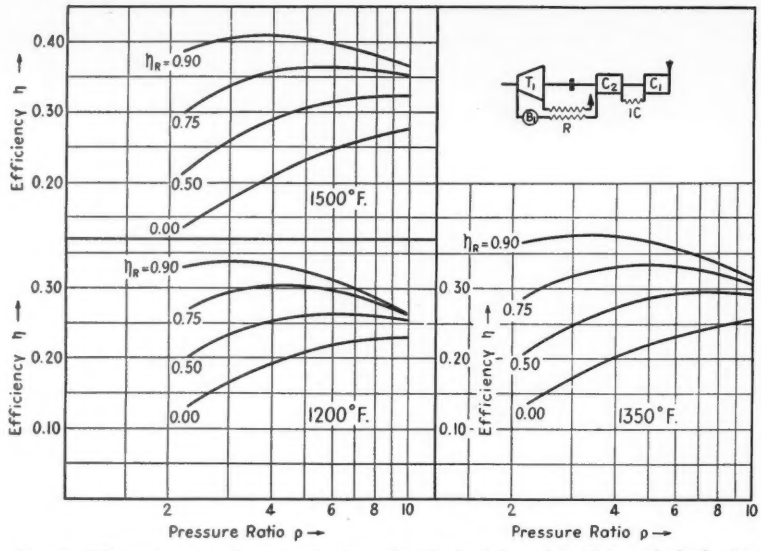


Fig. 4. Efficiencies at various temperatures for Cycle 1-1-η_R (one intercooler) showing effect of compounding compressors, as compared with Cycle of Fig. 2

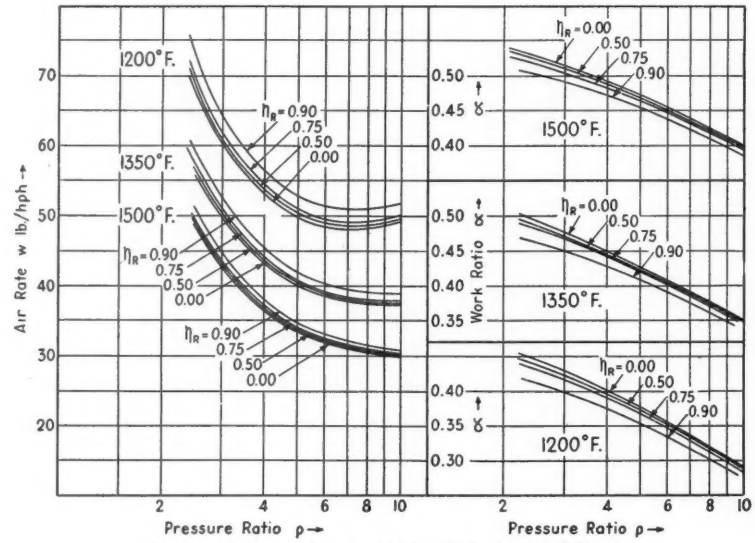


Fig. 5. Air rate and work ratio for Cycle 1-1-η_R of Fig. 4

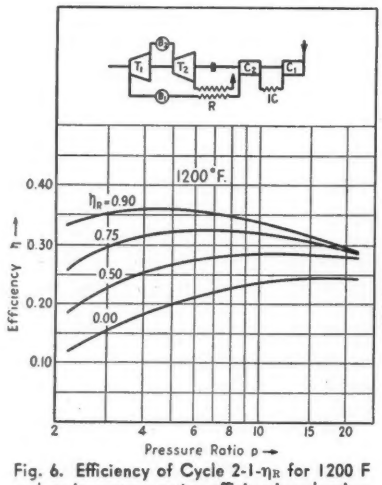


Fig. 6. Efficiency of Cycle 2-1-η_R for 1200 F and various regenerator efficiencies, showing effect of turbine compounding

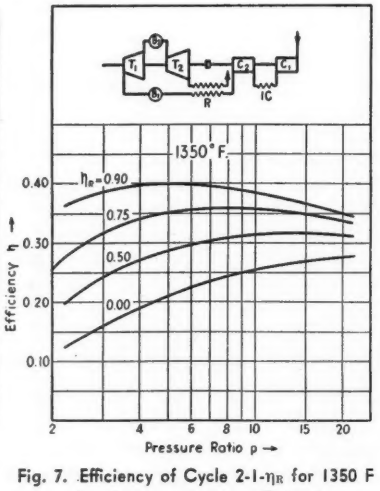


Fig. 7. Efficiency of Cycle 2-1-η_R for 1350 F and various regenerator efficiencies

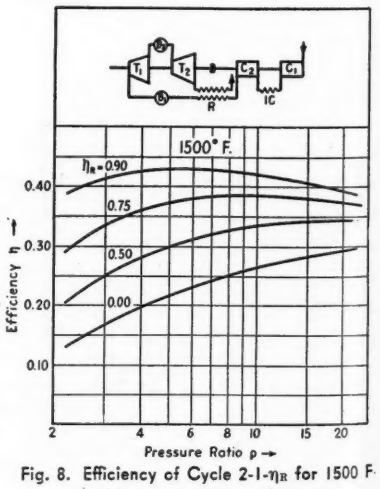


Fig. 8. Efficiency of Cycle 2-1-η_R for 1500 F and various regenerator efficiencies

obvious that they cannot be attained without careful design. They apply generally to units in excess of 1500 hp. Recent steam turbine developments have indicated that internal efficiencies of the order of 90 per cent can be obtained without abnormal construction, when the blading is proportioned for large flows and favorable aspect ratios. In this respect the gas turbine has an inherent advantage as compared with high-pressure steam turbines of equal power. While a compressor efficiency of 83 per cent is in excess of the commercial results obtained with centrifugal compressors, it has already been exceeded by multi-stage axial-flow machines. The newer types of constant-displacement rotary compressors are expected to attain at least this value.

Short-Hand Method of Describing Cycles

In considering the data shown in Fig. 11, a short-hand method of describing gas turbine cycles, originally suggested by Alf Lysholm, Chief Engineer of Aktiebologet Ljungstrom Angturbin, Sweden, will be used. This short-hand consists of a three-number designation, the numbers being separated by hyphens. The first number represents the number of combustion chambers, which is equal to the number of turbine expansions; the second number is the number of intercoolers, which is the number of compression stages less one; the third number represents the effectiveness of the regenerator or air preheater in the system. Thus, the symbol 2-1-0.75 represents the cycle shown in Figs. 6 to 10, having a regenerator efficiency of $\eta_R = 0.75$. This number is shown on each figure.

A study of these data indicates that by the use of the simple measures of intercooling, reheating and regeneration, thermal efficiencies can be obtained even with operation at 1200 F which are definitely competitive with the best existing power plants. Each stage of reheating or intercooling tends to increase the optimum pressure ratio, decrease the air rate and hence the size, as well as improve the efficiency.

Effect of Intercooling and Reheating

Perhaps the easiest grasp of these influences is obtained by the comparison given in Table 1 of the optimum performance for the three cycles, 1-0-0.75, 1-1-0.75 and 2-1-0.75. Compared with the simplest cycle, 1-0-0.75, the first stage of intercooling improves the optimum performance about 5 to 6 per cent; the first stage of reheating improves the performance an additional 7 to 9 per cent. Further elaborations of the cycle will yield additional gains, but at a diminishing rate. In Fig. 11 is shown a summary of the efficiency that may be anticipated with a variety of cycle combinations, operating with 75 per cent regeneration, at 1200 and 1500 F.

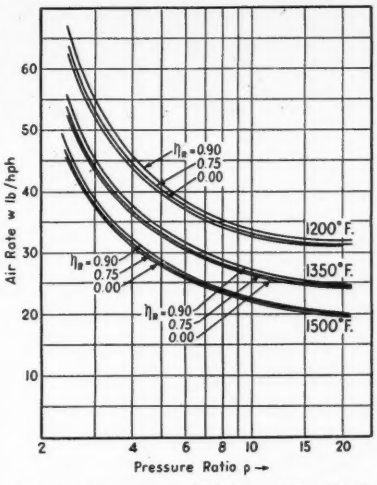


Fig. 9. Air rate for cycle 2-1-η_R of Figs. 6-7-8

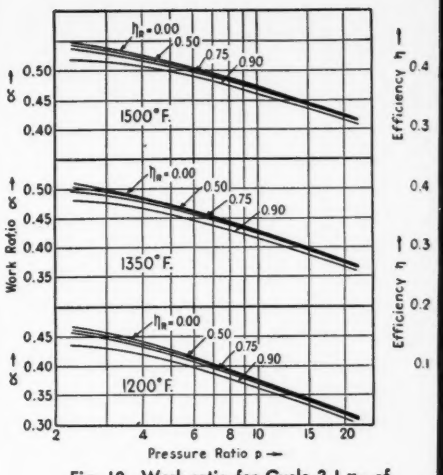


Fig. 10. Work ratio for Cycle 2-1-η_R of Figs. 6-7-8

Table I. Influence of Intercooling and Reheating. p = pressure ratio; η = cycle efficiency; ω = air rate; α = work ratio

Cycle	Symbol	$\eta_R = 0.75$, t = 1200 F: p, optimum	η, per cent	ω, lb per hp-hr	α, per cent
Single turbine, Single compressor, No intercooling, No reheat, Regeneration	1-0-0.75	3.5	28.7	63	36
Single turbine, Dual compressos, Intercooling, No reheat, Regeneration	1-1-0.75	4.5	30.2	52.2	37.8
Dual turbines, Dual compressors, Intercooling, Reheat, Regeneration	2-1-0.75	7.0	32.6	36	40

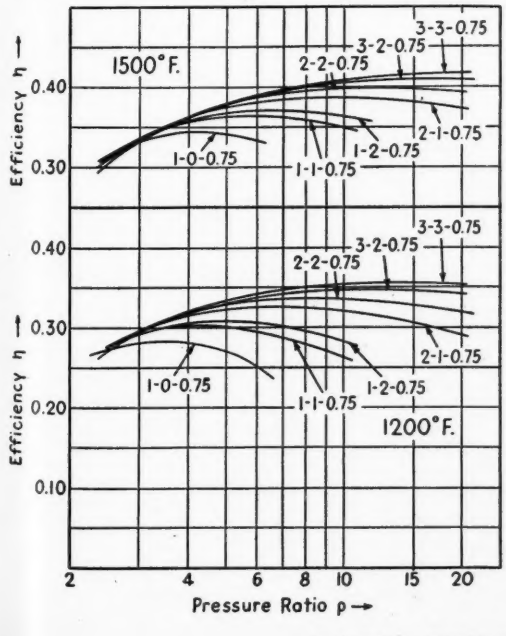


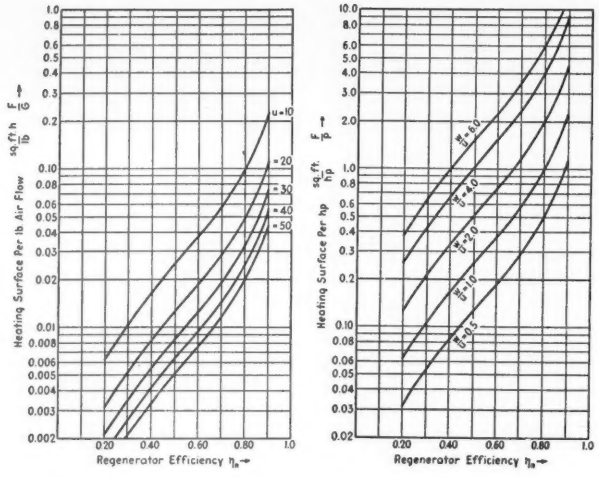
Fig. 11. Efficiencies of various gas turbine cycles for 1200 and 1500 F—see Figs. 2 to 10 and paragraph on short-hand description, page 72

An equally significant advantage resulting from the distribution of the cycle into multiple expansions and compressions is the reduction in the size of the plant by virtue of the marked decrease in air rate and, to a lesser degree, the increase in work ratio. From the mechanical as well as the thermodynamic standpoint, the scheme of multi-stage reheating and intercooling is ideal. Carried to the extreme, and in combination with 100 per cent efficient turbines, compressors, etc., it results in an efficiency the equal of that attained in the Carnot cycle. Mechanically and metallurgically it results in turbines of smaller physical dimensions with more nearly uniform temperature distribution. Any means by which the physical dimensions can be reduced and the inherent distortions minimized is a step toward greater reliability.

Regenerator Surface Required

To evaluate the influence of the regenerator efficiency, it is necessary to go somewhat further into the significance of this quantity. Denoting by U the overall heat transfer coefficient in British thermal units per hour per degree F per square foot, by F the effective surface in square feet, and by G the air flow in pounds per hour, it can be shown that an energy balance prescribes the following relations between the heat transfer surface and the desired efficiency of regeneration:

$$\frac{F}{G} = C_p \left(\frac{\eta_R}{1 - \eta_R} \right) \frac{1}{U} \text{ sq ft h per lb}$$



Figs. 12 and 13. Left—Fig. 12. Regenerator surface per unit air flow plotted against regenerator efficiency. Right—Fig. 13. Regenerator surface per unit of power plotted against regenerator efficiency

This relation is plotted in Fig. 12 for different values of U. In many cases it is important to measure the heating surface in terms of output power. This result is plotted in Fig. 13 for different values of the ratio w/U.

Heat exchangers designed with staggered multiple rows of tubes can be built within the pressure limits prescribed, having an overall heat transfer coefficient between 10 and 20 Btu per hour per square foot per degree F. In this connection, the adoption of finned and other indirect surface means is highly attractive.

Considerable confusion has existed on the subject of heating surface required, many exaggerated estimates of required heating surface having been made. On the basis of Fig. 13 it can be asserted that, within the scope of fairly simple heat exchanger equipment, it is possible to attain 75 per cent regenerator efficiency with from 2 to 3 square feet of heating surface per horsepower, providing a cycle of reasonable effectiveness is employed.

An increase in regenerator efficiency will always bring forth an improvement in thermal efficiency, but in general the optimum pressure ratio for the cycle is reduced, and the air rate is increased.

Figure 14, which for practical purposes covers all the cycles under discussion, illustrates the improvement in the optimum efficiency brought about by the addition of heat transfer surface to a cycle operating without regeneration. Up to a heating surface corresponding to $\eta_R = 0.75$ the improvement is rapid, but further gains require much larger increments of surface.

Part Load Performance

The full significance of the regenerator becomes apparent only when the conditions of part-load operation are considered. As a rule the prediction of part-load performance requires calculations of considerable complexity, so that a rough approximation of the part-load characteristics is highly desirable. Obviously, the most efficient part-load performance would be obtained, if the temperatures could be held while the air flow varied; on the other hand, the least desirable partial-load performance results when the air flow is maintained and the temperature level is lowered. Since a gas turbine plant is necessarily under fuel control, it is impossible even to approach variable-flow, constant-temperature operation unless reheating is employed.

Physical Arrangement

In the reheat cycle, it is possible to segregate one turbine and operate it under temperature control in such a manner that the quantity of air may be altered, and to maintain at the same time nearly constant-temperature conditions on the other machine. As a rule, this requires an arrangement in which the controlling turbine operates the low-pressure compressor at variable speed, with another turbine connected to the drive. While the schematic arrangement of the elements of such a cycle do not duplicate those shown in Figs. 6 to 10, the cycle characteristics remain unaltered. To the extent that additional stages of reheat are incorporated, with all except one expansion maintained at constant temperature, the ideal of constant-temperature, variable-flow performance is attained. Under these circumstances the part-load characteristic is closely approximated by the efficiency-pressure ratio curves, Figs. 6, 7 and 8, at constant regenerator efficiency. Practical experience shows, in fact, that even with only one stage of reheat this observation is still a fair approximation.

For the conversion into part-load performance the following procedure is used. If at the full load P_0 the specific air consumption is w_0 at the pressure ratio P_0 the partial load P will occur at the pressure ratio p and the specific air consumption w. For loads down to about 30 per cent, the following relation will hold with reasonable approximation:

$$\frac{P}{P_0} = \frac{w_0\ p}{w\ p_0}$$

As an example, take the cycle 2-1-0.75 at 1200 F and assume that $p_0 = 6.5$ and hence $\eta_0 = 0.325$, $w_0 = 36.7$; then for $p = 3$, there is obtained $\eta = 0.298$, $w = 53.8$. This corresponds to a fractional load of

$$\frac{36.7}{53.8} \times \frac{3}{6.5} = 0.315$$

at which the efficiency will be 29.8 per cent as against 32.5 per cent at full load. For the cycle 2-1-0, operating over the same range of pressure ratio, the full-load efficiency will be 21.6 per cent, whereas the efficiency at a pressure ratio of 3, corresponding to a fractional load of 0.32, will be 15.4 per cent.

Hence, without a regenerator the drop in efficiency between 100 per cent and 30 per cent load is more than three times as great as that which occurs with a 75 per cent regenerator. With respect to partial-load characteristics a gas turbine plant of this type has superior performance to many of the Diesel or steam plants now in operation.

Effect of Compressor on Part-Load Performance

Certain compressor characteristics are necessary to approach this ideal of partial-load perform-

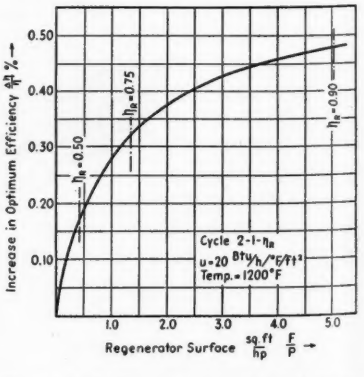


Fig. 14. Influence of regenerator surface on efficiency, showing improvement due to adding surface as compared to cycle without regeneration

ance, in which the temperatures are maintained as nearly constant as possible, while the air flow is varied. The positive displacement type of compressor, in which the flow is directly proportional to speed, with the efficiency and pressure ratio independent therof, is ideal. Centrifugal or axial-flow compressors, when operated at peak performance, deliver a pressure proportional to the square of the speed, while the flow is roughly proportional to the speed. The turbines, on the other hand, demand a pressure proportional to the flow over a large portion of the load and speed range. This means that the turbine pressure requirement follows a linear speed relationship, while the pressure delivered by the compressor is a quadratic function of the speed. Until such time as the stability range of the centrifugal-type of compressor has been extended materially beyond that of present-day practice, partial-load control must be obtained by the variation of both temperature and flow. Much work remains to be done on this subject before the partial-load characteristics of gas turbine plants with centrifugal compressors can be predicted with certainty.

Mechanical Aspects of Gas Turbine Plants

The successful progress of the gas turbine is, of course, intimately tied to metallurgical developments of heat and corrosion-resisting materials. The principal reason for the difference of outlook at the present time, as compared to a half century ago, is the availability of metals which can sustain appreciable stress at temperatures above 1000 F without failure, excessive creep, corrosion and other difficulties. The developments of recent years are particularly noteworthy, but the most important data are not now available for publication.

In judging the suitability of any material for applications of this nature the following considerations have gradually emerged:

1. Creep to rupture strength. When subjected to the simultaneous application of steady stress and temperature, failures will occur after a certain length of time, resulting in a stress-time curve, which bears some resemblance to the S-N curve in fatigue.

2. Ductility of failure. In general, the fractures take place at decreasing ductility (as measured by the reduction of area) as the time of failure is increased. Materials with high creep to rupture strength usually fail at lower ductility.

3. Creep deformation. The total deformation increases very rapidly with stress and temperature, and a change of dimensions of stressed parts must be considered as one of the unavoidable premises of the design.

4. Fatigue strength at high temperature. One of the advantages of the turbine is that alternating stresses, while not entirely absent, do not play a dominant role. As a rule, however, the fatigue strength of modern alloys at 1200 F appears to be about the same as the creep to rupture strength for equivalent times of service. Hence, if the alternating components of the stresses can be kept small, the fatigue problem will not generally be a major consideration, unless corrosion fatigue, as well it may, introduces additional risks of failure.

5. Corrosion resistance. The hot machine parts will usually operate in an oxidizing atmosphere, and the corrosion resistance must be judged with this in mind. It is a fortunate coincidence that the same metallurgical measures which improve hot strength, generally bring about improved corrosion resistance.

6. Workability. The development of machine shop practices have kept in step with the development of metals, so that in general some means have been found to forge, cast or machine most of the metals now in existence. Large forgings of newer alloys are not easily obtainable, however.

Metals Available

Without going into the details of the alloys now available, it may be stated that turbines can now be designed for operation at an inlet temperature of 1200 F, which may be expected to show the same degree of reliability as existing steam turbines operating at 900 F. In many of the related fields operating temperatures in excess of 1200 F have been in use, and predictions of the future of the gas turbine are often made on the premise that materials will eventually be available which would permit reliable sustained operation at 1500 F or even higher. It is hazardous to predict the future in this respect, but the authors do not share this optimism with regard to the uninterrupted advance of operating temperature for long-time service. Moreover, the data on efficiency do not indicate that extremes of temperatures are absolutely essential in order to justify gas turbine developments in the immediate future.

It must not be forgotten that the use of metals under high stress, above 1200 F, is an undertaking fraught with many uncertainties. In some respects it may be compared to the shifting to a brittle material like cast iron for the buckets and rotors of conventional turbines at lower temperatures.

Many of our present concepts of design are predicated upon a criterion of failure defined by the yield point. While this has been entirely satisfactory in steam turbines at moderate temperatures, largely by virtue of our ability to secure materials with low creep rates, it is doubtful whether this premise can be translated into gas turbine design practice. The most sensible approach at the present time would appear to be the adoption of the creep to rupture strength for the appropriate time of service as an ultimate strength, accompanied by an adequate factor of safety. This reduces the working stress of such parts as turbine buckets to the range of 6000 to 8000 psi at 1200 F.

General Design

Every advantage can be taken of the advance in the art of building steam turbines, and many of the troublesome features of high-pressure steam turbines disappear altogether. Usually, the volume flow is larger and much more satisfactory stage proportions can be used. Control valves in the usual sense are not required, and all forms of partial admission or bypass stages will be absent. As a rule, end leakage will be less important and there should be no difficulty in disposing of the leakage flows.

While internal cooling of buckets and blades does not now appear necessary, an auxiliary air-cooling arrangement to protect the bearing structures, and to avoid extremes of temperature in the supports, is essential.

Most of the materials now available for high-temperature service are of the austenitic type in which the coefficient of thermal expansion is about 50 per cent greater than that of ordinary steel. This, with the higher temperatures, places an added responsibility on the designer to provide sufficient

(*Continued on page* 118)

How To Make Your Transformers Do More Work

Are many of your transformers carrying more load than they should? Would you like to increase the carrying capacity of those you have? This article tells how you can help them along. It is comparatively simple. All you have to do is to provide means for removing the heat losses more rapidly. In most cases fans will do the trick, in others, a change in the oil cooling system may be desirable. The authors show various types of fans and fan arrangements which have been developed in recent months to increase the carrying capacity of existing transformer installations.

By

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and

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Renewal Parts Application

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EXPANDING war production is making demands for more and more power on the electrical systems of the country. With material shortages delaying installation of badly needed new power facilities, engineers responsible for the operation of the systems are faced with the problem of getting more kilowatthours out of existing equipment. With the cooperation of operating companies, our design engineers and application engineers have developed many methods for getting more kilowatthours out of existing equipment.

Power Transformers—What Can Be Done With Those Now In Service?

Most power transformers have reserve capacity over and above the nameplate rating. Some of this extra capacity can be turned into more kilowatthours for victory by taking advantage of low ambient temperatures. Short time overloads of several hours' duration are also possible, even at normal ambient temperatures. Transformer engineers have recently compiled rules for overloading (See AIEE September, 1942, "Interim Report on Guides for Overloading Transformers") which should prove very useful in these critical times.

To get this additional capacity out of existing equipment, the customer needs to go to the manufacturer who built the equipment in order to get the answer as to how much additional capacity can be obtained by some auxiliary means of cooling, and what that auxiliary means of cooling should be. The customer needs to take this matter up with the manufacturer of the existing transformers because other points of design, besides the oil temperature might establish the limitation of the maximum output available.

In the application of coolers to existing transformers, the number and size of the cooler would be determined by the losses to be taken care of at the maximum load and the size of the openings into the transformer as it is now installed.

In addition to the emergency overloading described in the "Interim Report", many transformers are capable of greater capacity by an increase in the cooling facilities. To determine what can be accomplished by enlarging or improving the cooling system, each situation must be engineered and investigated as an individual problem. We can only suggest possibilities, because the amount of overload that can be obtained from transformers now in service, as distinguished from new transformers, depends entirely upon

Fig. 2. Close-up view of the radiator hood type of blower

Fig. 1. Motor driven fan used on transformer blower equipment

Fig. 3. Multi-fan banked type of blowers installed on transformer radiators

the design and present physical condition of the unit under consideration. The type of auxiliary cooling equipment is chosen by careful consideration of the characteristics of the transformers in question. The amount of overload possible is dependent not only upon thermal characteristics, but also on the current carrying capacity of the terminals and loads of the original design.

How Can This Be Accomplished?

Existing transformers can be utilized more effectively by increasing the output of the units

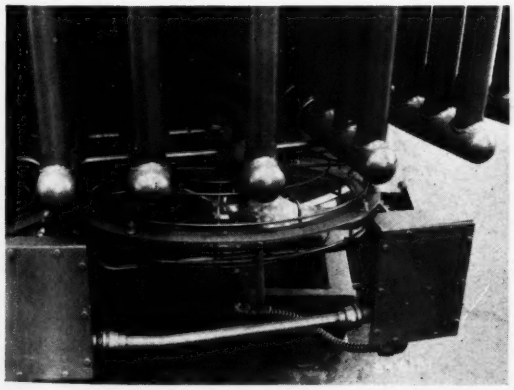


Fig. 4. Close-up view of cooling tube blowers as installed below radiator

in either of the following ways:

(A) By the addition of fan blower equipment to oil-immersed, self-cooled transformers, the output can be increased in some cases up to 33⅓ per cent. This type of installation involves equipment that uses a comparatively small amount of critical material. Approximately two pounds of copper are required for each fan motor and the amount of steel is relatively small when compared to the additional transformer capacity obtained.

(B) By the addition of external coolers, with forced-oil circulation, to oil-immersed self-cooled or water-cooled transformers, the output can be increased in some cases up to 50 per cent. The coolers may be either air-cooled or water-cooled.

Fan and Motor Assembly

Figure 1 shows the fan and motor combination used on Westinghouse transformer blower equipment. Either single or three-phase units are available for use on 220 v, 50 or 60 cycle circuits. The motors are rated 1/12 hp, 1750 rpm and are of weatherproof construction. Semi-sealed greased-for-life ball bearings definitely eliminate the lubrication problem. The single phase two-winding motor uses a capacitor for start and run; it operates as induction type, thus eliminating the need for brushes, slip rings or centrifugal cut-out devices. The propeller, a special patented air-foil design, moves a maximum volume of air for the power consumed and has a low sound level.

Radiator Hood-Type Blowers

Figure 2 shows the hood-type blower equipment, designed for use with Westinghouse (or Shaw-Perkins) radiators, consisting of a conical hood that covers a section of the radiator. A small motor and fan mounted in the outer end directs a column of air into both sides of the radiator fins. The short simple duct system eliminates the need for a high pressure type fan; the free air delivery of the fan is efficiently utilized; thereby resulting in low power consumption. The hood and component parts are of rugged welded construction and are especially designed for ease of installation. The complete blowers—light, compact, easily handled—are interchangeable and all motors are independently accessible for simplified maintenance and fusing.

Multi-Fan Banked-Type Blowers

Figure 3 illustrates how this type of air blast equipment is applied when the radiators are arranged in banks. The radiators must be of the type that have cooling elements arranged parallel to each other. It is necessary to have a group of continuous air ducts throughout the length of the radiator bank because the cooling elements are in alignment. The blowers are individually attached to the side of the first radiator and the blast of air from the fans passes through the cooling elements of fins of all radiators in the bank. This form of auxiliary blower equipment gives high operating efficiency because there are no directing baffles, and the entire air output is delivered to cooling surfaces. This type of installation does not increase the overall floor space required and the general installation is easily and quickly accomplished. The units are interchangeable and each fan is independently fused, so that the failure of one in no way affects the others.

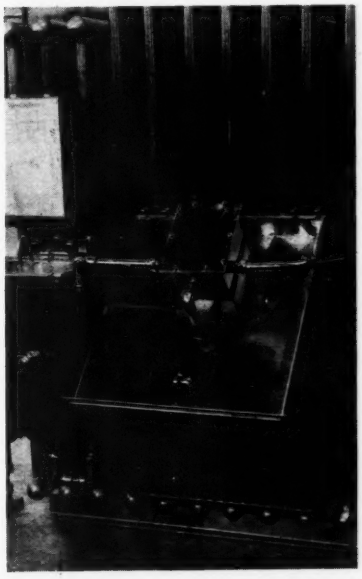


Fig. 5. Hood type cooling tube blowers

Cooling Tube Blowers

Figure 4 shows how blowers can be applied to older designs of transformers having cooling tubes.

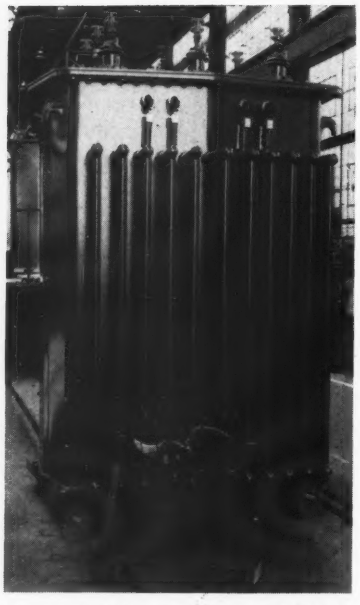


Fig. 6. Portable unit blower installed for transformer cooling

However, in some cases there is not sufficient room below the tubes to accommodate mounting the fans. Where the installation is possible, it becomes a very desirable arrangement. The air stream is directed upward and slightly inward to provide a column of cool air throughout the entire tube region. The air supply is taken from the floor level, thus utilizing the coolest air available. Directed upward, the forced air stream augments the natural convection of the transformer cooling system and the heated air is carried away without any tendency toward recirculation. This type of blower installation is applicable to either round or flat tubes.

Hood Type Cooling Tube Blowers

Figure 5 shows a modified hood type blower designed especially for application to transformers employing cooling tubes which extend near the floor or base. It consists of a sheet metal hood complete with a fan and motor assembly and the fan end is protected by a removable guard. The advantages of the upward air movement are the same as for the standard cooling tube blower previously mentioned.

Portable Unit Blower Equipment

Figure 6 shows the portable air blast equipment designed to meet the demand for auxiliary cooling of station apparatus where seasonal or emergency overloading occurs. It consists of a fabricated steel stand supporting a fan mounted in a protecting guard. The air stream may be directed downward or upward at any angle by merely adjusting the fan mounting. The fan and motor assembly is designed for exposed, outdoor operation and is the same as used on the other types of Westinghouse blower equipment. Easily handled because it weighs only 70 pounds, the unit may be plugged into a temporary source of station power. It can be operated as an emergency cooling unit or may be permanently mounted and connected through a standard automatic air blast control. Efficient and durable, it takes care of emergency transformer overloads quickly and inexpensively.

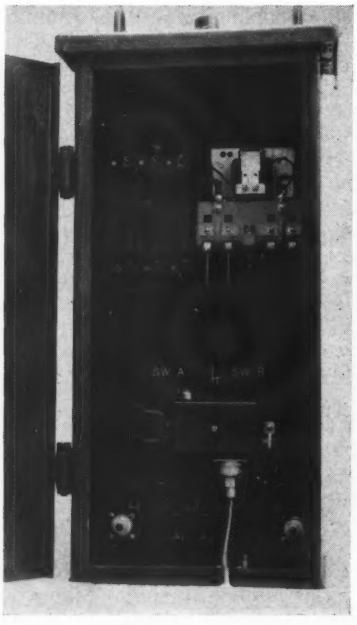


Fig. 7. (Left) Control equipment for large transformers

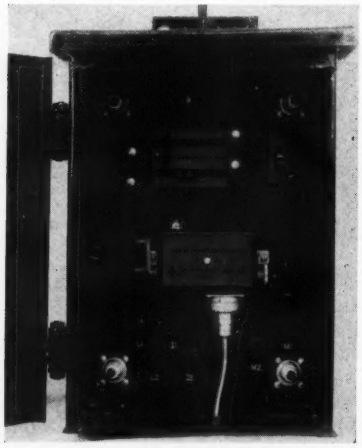


Fig. 8. (Above) Control equipment for small transformers

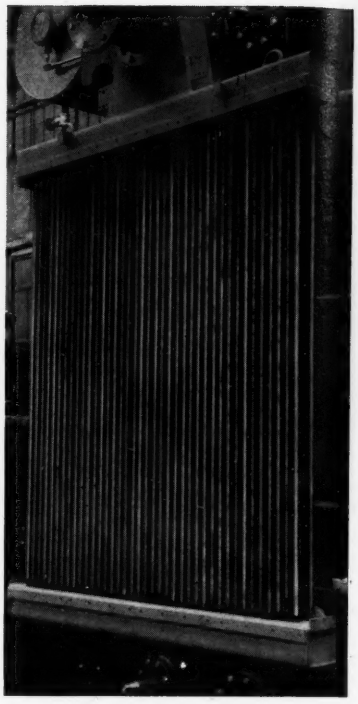
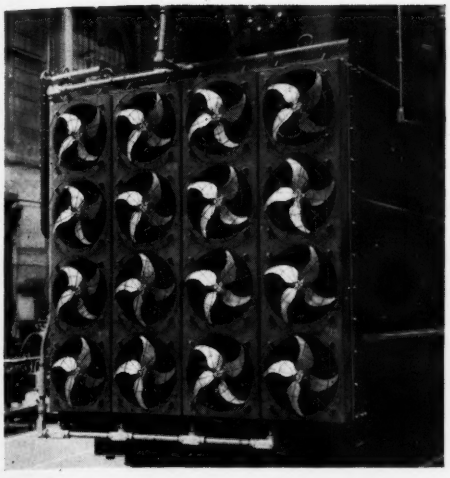


Fig. 9. Forced oil cooling only

Control Equipment—Large Transformers—Automatic

Figure 7 shows the weatherproof cabinet with hinged doors and the panel equipped with terminal posts for incoming and outgoing power circuits. A line-start Deion contactor is operated by a solenoid coil; a Deion AB line breaker, with thermal overload trip, serves to de-energize the panel for maintenance. Two flip-on switches in the control circuit permit manual control of the motors for testing purposes and two auxiliary contactor circuits are available for station purposes.

Automatic control of the contactor solenoid is provided through use of a thermostat, actuated by top transformer oil temperature. The closing temperature can be selected within a range of 50 to 100 C and a second adjustment varies the temperature differential between on and off settings. This permits regulation to avoid repeated starting and stopping of the equipment on small temperature changes. The bulb of the thermostat is mounted in a stand-



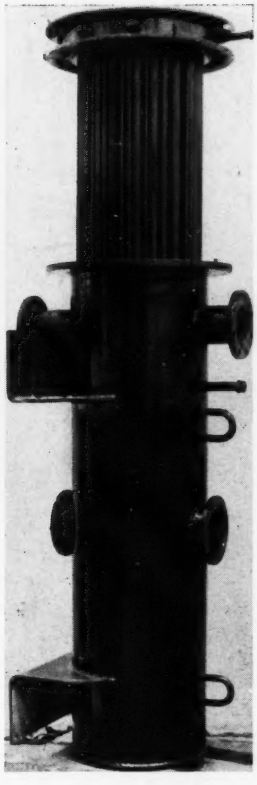


Fig. 10. (Above) Forced oil cooling plus oil-to-air cooling

Fig. 11. (Right) Oil-to-water; Tubes partially removed from jacket

ard pipe tap hole in the transformer cover and a flexible armored capillary tube extends down the tank wall to the mechanism mounted on the panel.

Manual

Manually controlled equipment utilizes the same cabinet and panel used for automatic installations, except that the thermostat is omitted. Controlled by flip-on switches it can be converted to the automatic type at any time by the addition of the thermostat. Standard transformer cover fittings are often provided to facilitate making the change-over.

Control Equipment—Small Transformers

Figure 8 shows the control designed for operating up to six single phase fan motors from one panel. It consists of a weatherproof cabinet with hinged door; the panel carries a Deion AB breaker, a control thermostat, a manual flip-on switch, and terminal posts for incoming and outgoing power circuits. The Deion breaker has a thermal overload trip and is also used to clear the fan bus for maintenance operations. The flip-on switch permits starting the fans for testing in case the thermostat is open.

Automatic control of the contactor solenoid is provided through use of a thermostat, actuated by top transformer oil temperature. The closing temperature can be selected within a range of 50 to 100 C, and a second adjustment varies the temperature differential between on and off settings. This permits regulation to avoid repeated starting and stopping of the equipment on small temperature changes. The bulb of the thermostat is mounted in a standard pipe tap hole in the transformer cover and a flexible armored capillary tube extends down the tank wall to the mechanism mounted on the panel. One auxiliary circuit is provided for use as a signal lamp connection.

Forced Oil Cooling with Type FA (Oil-to-Air) Cooling

Figures 9 and 10 show the Westinghouse Type FA cooler, designed for mounting on radiator flanges or openings of approximately drain valve size, and intended especially for existing transformer installations. Consisting of a number of seamless steel tubes welded into structural steel headers, the units are attached to the transformer tank by means of flanged couplings. Each tube is spiral wound with copper finning in order to increase heat radiation. The centrifugal pump and housing are placed on top of the header and a valve permits removal of pump or cooler without loss of oil from the main tank. The pump impeller is directly connected to the motor shaft.

The motor and impeller form a detachable unit, which is joined to the impeller housing by a flanged coupling. The motor is cooled and lubricated by the transformer oil in which it is submerged. This elimination of an external shaft and stuffing box avoids the possibility of oil leaks. In order to realize the maximum dissipation of heat from the cooler, a large volume of air is forced across the surface of the fins by means of fans similar to those described above in Fig. 1. The fans are assembled in units housing one to four fans each. Though normally supplied with three phase 220 v motors, these fan units, as well as the motor-pump units are also available for use on single phase supply circuits.

Forced Oil Cooling with Type FW (Oil-to-Water) Cooling

Figure 11 shows the component parts of the compact Westinghouse oil-to-water cooler, which when used with forced oil circulation provides a compact unit with a neat appearance. It may be applied to existing transformers by mounting on openings of drain valve size. A bundle of steel tubes is bolted inside a steel shell using an oil tight flanged joint at the water inlet end, and an independent support at the other end and the tubes are coated with corrosion resistant baked enamel. The outer shell may be removed for tube inspection and cleaning without breaking the oil connections. On the side of the shell is an inspection plate which may be removed in order to determine whether cleaning is necessary. Inlet and outlet oil lines are constructed for flanged bolted connections and there are no gasketed joints between the oil and water compartments. The oil is pumped through the tubes in a continuous flow that assures a high transfer of heat to the cooling water; the amount of water to be circulated is determined from the design characteristics of the transformer.

The oil pump and motor form a detachable unit which may be removed without loss of oil from the transformer tank. Entirely sealed, the motor is lubricated by the transformer oil and since the pump impeller is on the end of the motor shaft, no stuffing box is required. Valves are furnished which permit removal of the entire cooler without disturbing the oil in the tank. Though normally supplied with three phase 220 v motors, these motor-pump units are also available for use on single phase supply circuits.

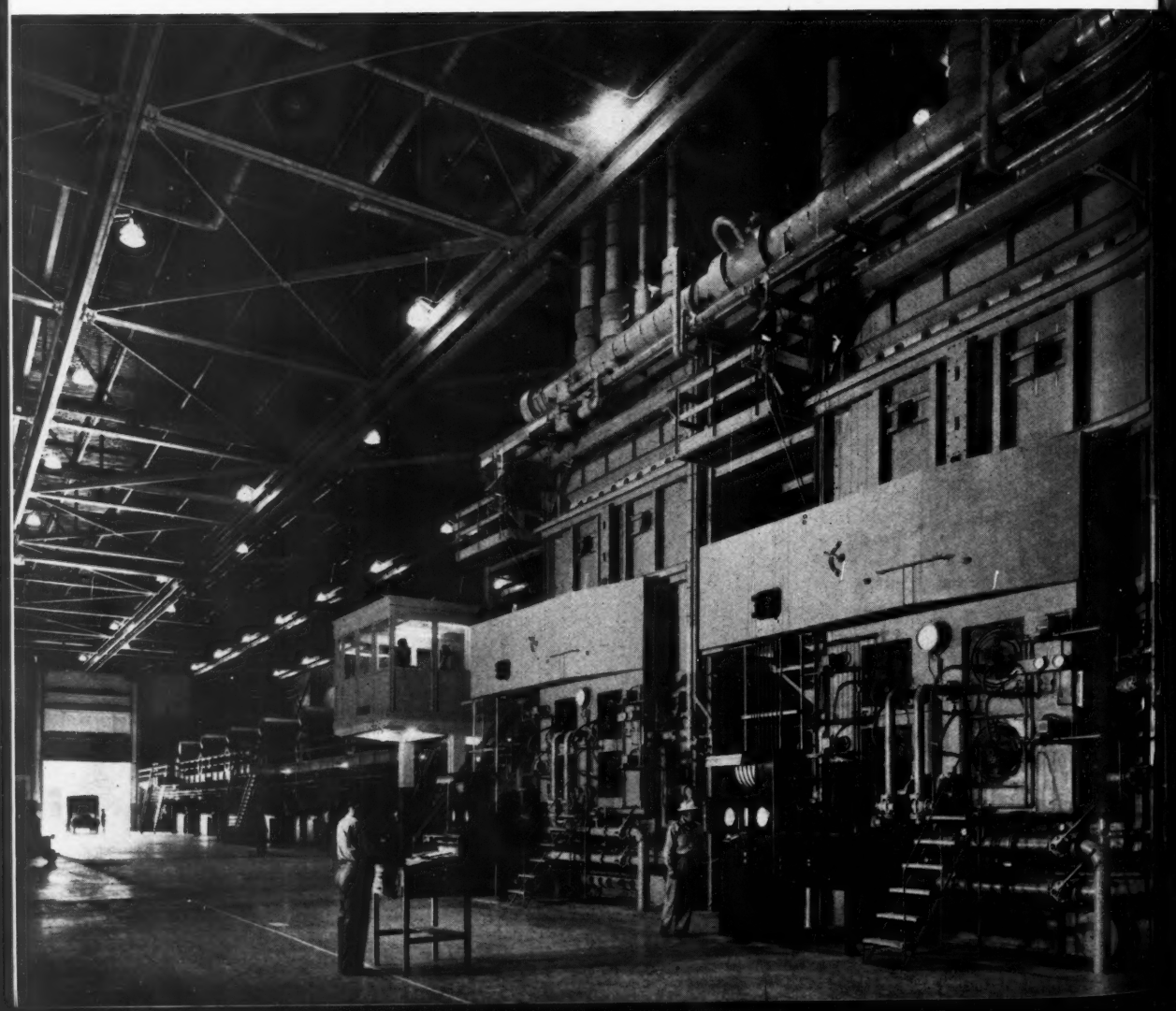


Fig. 3. Chief engineer's office on mezzanine. Just outside are control panels for the air conditioning system throughout the plant

Engineering Services for a Controlled-Conditions Plant of Douglas Aircraft Co.

By

A. D. Engle and *W. W. Frankfurt*

Project Manager *Project Mechanical Engineer*

THE AUSTIN CO.

TO SERVE the engineering needs of a large aircraft manufacturing plant of Douglas Aircraft Co., Inc., in Oklahoma, which is housed in an unusual and interesting type of building, designed for production operations at optimum efficiency, an extensive steam-electric-compressed air-refrigeration plant, as described and illustrated in this article, has been installed.

Two miles of "breathing" windowless walls, built entirely of masonry, as shown in Fig. 8, and a roof of fiberglass and steel construction are important elements in the thoroughly insulated enclosure which constitutes this new controlled-conditions aircraft plant. Undertaken under an architect - engineer - management contract with the U. S. Army Corps of Engineers in the face of conditions which required conservation of critical metals, the entire project was designed with a view to using local materials to the greatest extent possible.

The accompanying photographs, Figs. 1 to 7, show various views of the boiler house where the vital engineering services originate. It contains: gas-or-oil-fired boilers to generate steam for heating and process work and for driving refrigeration compressors for air conditioning; an installation of gas engine units that drive both air compressors and electric generators; a battery of steam-turbine driven centrifugal refrigerating units; a water treatment system; and complete centralized control for the engineering facilities of the plant. A cooling tower serves the refrigerating units, domestic water is pumped from nine deep wells, there is an extensive fire protection system and a complete sewage treatment plant.

Distribution facilities for electricity, steam, compressed air, conditioned air and all other services are designed along lines largely determined by the open layout of the manufacturing buildings, as shown in the illustrations. Since this is a windowless building, the methods of illumination and building construction are of great importance.

Boilers Serve Heating and Cooling Functions

Boilers of the waterwall type generating saturated steam at 215 psi, are installed as shown in Fig. 2. They are gas fired, with oil for standby. Forced and induced draft fans and boiler feed pumps are steam-turbine driven, utilizing exhaust steam from these turbines for boiler feedwater heating. During the winter, the boilers furnish steam primarily for heating and processing equipment; during the summer they supply steam for the refrigeration machines and proces-

All photos courtesy The Austin Co.

Fig. 1. (Top, Opposite Page) View in boiler house showing the line of 1075-ton steam turbine-driven centrifugal refrigeration machines on mezzanine, steam condensers under it. Chilled water headers along wall behind machines. In right foreground, gas-engine-driven-air compressor-generators

Fig. 2. (Bottom, Opposite Page) Two of the gas-and-oil-fired 215-psi boilers in foreground, showing automatic combustion control and flame failure protection panels, burners and forced draft ducts, main steam piping overhead. Gas, oil and continuous blowdown piping run in trench below floor. Refrigeration machines in background. Note that chief engineer can see entire room from office on mezzanine just beyond boilers

Fig. 4. (Right) View in boiler house showing the three gas-engine units driving air compressors and flywheel type electric generators for emergency lighting service. On mezzanine behind engines are main switchgear for boiler house, control switchgear for main substation and automatic emergency switchgear for generators, a low-voltage substation, and at right, air compressor aftercoolers. Gas-engine exhaust lines with silencers run up the wall, boiler house air intake with control in end wall

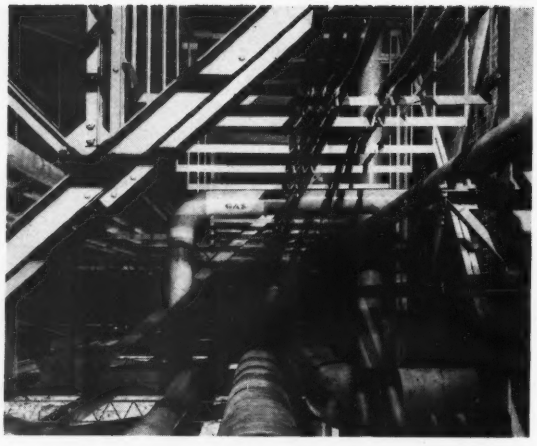


Fig. 5. All distribution systems in plant are in the roof trusses, leaving working area entirely free of obstructions. The two 18-in. pipe lines in lower foreground carry cold water. Upper left, pneumatic tubes and a 6-in. compressed air line. Lower left, with branch cutting across at right angles, a 10-in. gas feed line. Above, armored cable in 900-ft lengths without splices, supported by special Austin hangers, carries 4160-v 3-phase power, with multiple neutral conductors to keep diameter at minimum and prevent heating

Fig. 6. At left, feedwater softener and heater in boiler house; in center, steam-turbine-driven boiler feed pumps; at right, domestic hot water heater and a tank and heat exchanger for reclaiming heat from continuous blowdown system for preheating feedwater heater makeup. Behind feedwater heater are filters. Operating platform on wall above pumps gives access to pressure-reducing valves on office building heating system lines

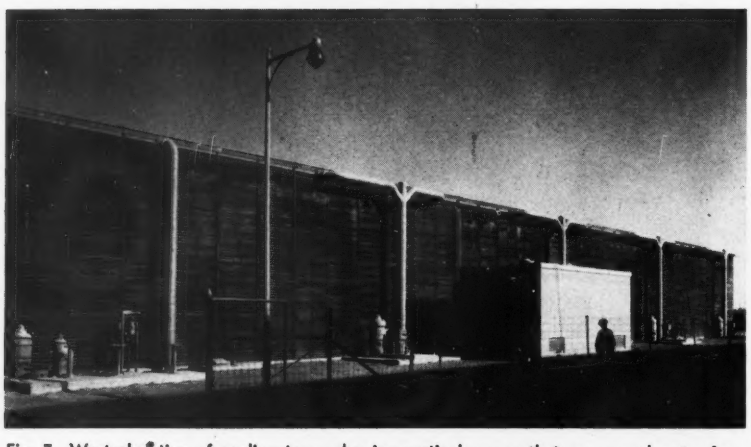


Fig. 7. West elevation of cooling tower showing vertical pumps that pump cool water from tower basin to boiler house. The five vertical risers return warm water to top of tower. House at lower right houses condenser water pump switchgear

sing equipment. Peak loads of both seasons are approximately the same, hence full service is rendered by the boiler plant.

To protect boiler tubes and drums against scale and corrosion, a hot process water softener, shown in Fig. 6, is used for treating boiler feedwater. Low total solids are maintained in the boilers through a continuous blowdown system, thereby producing high quality steam. The boiler blow-off discharges into a concrete tank, located below the boiler room floor, through an aspirator located below the water line. This provides thorough circulation and mixing of the hot condensate and the water in the tank before discharging to the sewer. During blow-off periods, cold water is admitted by the operator at the throat of the aspirator. This dilution of the hot condensate with cold water prevents excessive strains to the concrete tank due to temperature rise.

Gas Engines Serve Double Purpose

Compressed air is provided at 100 psi working pressure by five 2-stage compressors. Two of these are direct connected to 300-hp, 4160-v synchronous motors. The other three are twin, two-stage, horizontal type compressors, each driven by a combined 8-cylinder 300 hp vertical V-type gas engine, shown in Fig. 4. Each gas engine is also direct-connected to a 200-kw, 4160-v fly-wheel type generator. Any two generators will handle the emergency lighting loads in the event of main power failure. Provision is made for automatic unloading of compressors during this period and placing air compressors back in normal operation when the generators unload.*

A two-way damper is provided at the compressor air intake so that the operator may draw the driest air from either inside or outside the building, depending on the moisture content, thereby making for a more efficient operating system. A loop distribution system is provided, with the compressors located near the heavy concentrated loads. Numerous drops are made at columns for processing equipment and large machines. Also air service outlet boxes for small hand tools have

*For a detailed description of these units and the method by which they are automatically controlled, see Compressed Air Magazine, February 1944, pages 41-43: Gas Engine Units Compress Air and Generate Electricity, by W. M. Gebo.

been provided in the floor in various areas.

Acetylene gas for processes is supplied by two 300-lb double-duty generators, oxygen and hydrogen by manifolded cylinders, all located in one central plant. The three gases are distributed to the various welding areas by pipe lines identified by distinguishing colors. Tile welding booths have been provided to confine welding operations and to protect the employees' eyes from ultra-violet rays.

Air Conditioning

The designs for air conditioning systems and other mechanical facilities were developed around standard units insofar as possible, to expedite delivery and insure a minimum of difficulty in future replacements and maintenance. The heart of the air conditioning system is in the boiler house where eight 1075-ton centrifugal-type refrigeration machines cool 18,200 gal of water a minute. The machines are located on concrete decks 12 ft above the main floor, as shown in Fig. 1.

Each compressor is driven by a steam turbine operating at 215 psi steam pressure, with exhaust at 26 in. Hg. Steam condensers and condensate pumps are located under each refrigeration machine on the main floor, to simplify piping connections. Adjacent to and in full view of the refrigeration decks is the main air conditioning control panel, Fig. 3, which gives the operator a full picture of the actual operating conditions throughout the plant.

The main boiler house building columns were utilized to support the 24-in. chilled water headers and branches to the coolers on the refrigeration deck. The chilled water system is divided into four zones, each having its own circulating pump together with sectionalizing valves and by-passes so that, in case of an emergency, pumps can be cross-connected. A total of 18,200 gpm of chilled water is transported through pipes to the various fan decks throughout the building. Light gage spiral pipe was used where practical in order to save critical materials.

Large Cooling Tower

A nine-section, induced-draft type tower, designed to cool 26,100 gpm, was erected on a concrete basin with five sump pits located on one side. This is shown in Fig. 7. A low-head, deep-well type pump was installed in each sump pit for circulating condenser water to the refrigeration and

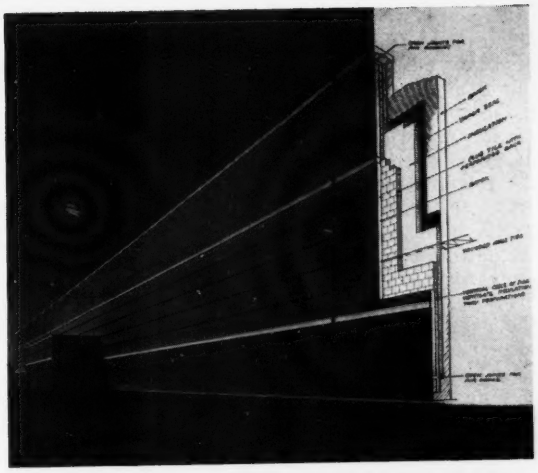


Fig. 8. In assembly plant are nearly two miles of wall like this, containing 17,000,000 common brick. To save critical material, ferroglass, an Austin construction, was used only in the roof where it provides light reflection, sound absorption and insulation. The "breathing wall" has open vertical joints at top and bottom as shown, ventilated tile, a 4-in. mat of rockwool and a water-proof membrane vapor seal inside. It has insulating value of 80 in. of brick

Fig. 9. Air conditioning units throughout plant are all located like this on platforms in the roof trusses, and are accessible from cat-walks running full length of plant. Lighting units are suspended from bar joists that rest on the monorail supports. Note clear working space below

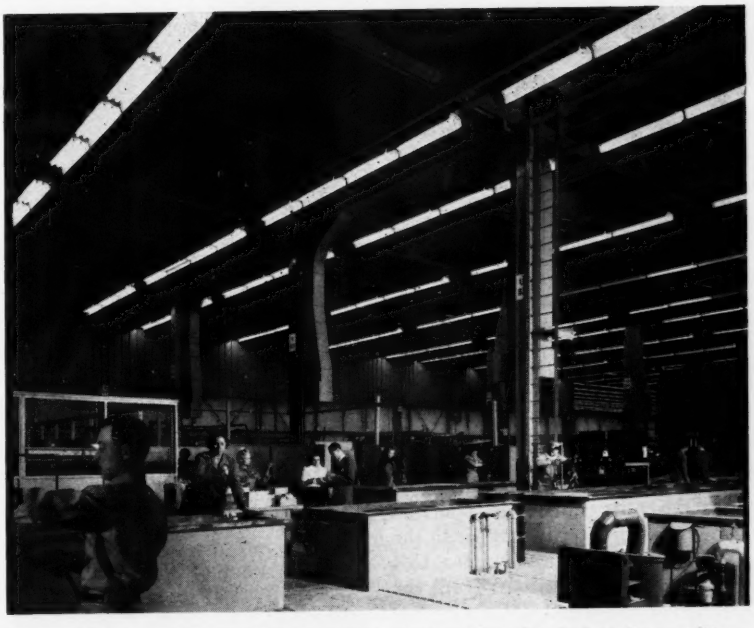


Fig. 10. View in cadmium plating department gives an idea of typical working conditions, lighting fixtures, air conditioning ducts, absence of columns and obstructions. Air conditioning control obviates need of partitions that would interfere with free-flowing production. Metal curtains, in background, extending 10 to 15 ft below bottom chord of roof trusses, trap special process heat and gases which are exhausted to outside by fans and blowers

steam condensers. Some 200 gpm of water returning from processing equipment is used for water make-up at the tower, thereby conserving water. The 42-in. underground condenser headers at the tower were anchored by concrete thrust blocks designed to fix the pipe and prevent expansion in the line along the tower due to temperature change. Installation of these thrust blocks permitted the use of lighter gage pipe and branches, saving critical material. Condenser water is also used for cooling the gas-engine-driven air compressors the year round.

During the winter time, one section of the tower, together with a small circulating pump, is used for the gas engines. The tower piping is so arranged that, depending upon the outside temperature, water can be discharged either at the top of the tower or directly into the basin. Steam pipe coils have been installed in this one basin to prevent freezing of the water. Cooling tower water is also used to cool the water-cooled bearings on the induced and forced draft fans of the boilers and on the boiler feed pumps.

Units and Piping All in Trusses

Due to clearance requirements of the overhead monorail covering the entire ceiling, the air conditioning system had to be completely installed above the lower chord of the trusses, as shown in Figs. 9 and 10. Two complete air conditioning units were assembled on each of the thirty fan decks, which condition 3,500,000-cfm of air, with a penthouse above each fan deck for drawing in outside air and for expelling the used air through relief dampers. Air is distributed from each fan deck through ducts to ceiling type air diffusers located on 60-ft centers.

Special heating control equipment was provided for large vertical lift doors by installing a thermostat at a low level. This thermostat, when calling for heat, will open a steam valve in the line to a booster coil located in the branch duct. As the air temperature rises in the duct, a heat-actuating device located at the air diffuser automatically opens its bottom vanes and directs the hot air to the floor, thus compensating for this varying infiltration load from the door. The fan decks are connected by a network of catwalks which permit the operators to make adjustments without affecting the production operations below.

Nine Wells for Domestic Water

Domestic water is supplied by nine deep wells located 1000 ft apart, drilled to approximately 800 ft deep. Each well is supplied with a turbine-type pump of 200 gpm rated capacity against 800 ft total head. This unit is powered by a vertical 60 hp motor. Each pump consists of two parts. At the intake, approximately 650 ft below the pump head, there are twelve 8-in. bowls, which lift the water 280 ft to a 21-stage, 8-in. bowl booster pump which forces the water into the distribution system and into the elevated storage tank. The pumps are automatically controlled by the water level in the tower. The domestic water is treated by adding chlorine, automatically fed into the system by standard chlorinators, governed by the rate of flow of the water through orifice plates at points of application. Water is chlorinated to maintain 0.4 gpm.

Comprehensive Fire Protection

The fire protection system consists of outside two-way, gate-valved hydrants located 400 ft apart, all around the plant. The inside first-aid appliances consist of an independent standpipe system with small hose stations located about 200 ft apart throughout all buildings and also above the roof of the Assembly Building. Various types of hand extinguishers are placed where need for them is anticipated, the types varying from carbon dioxide chemical engines on wheels to the carbon tetrachloride pumps for electrical fires out of reach of foam or CO_2. Foam extinguishers are placed near where a fire may be expected around greasy or oily machinery.

On each column in the Assembly Building is placed some piece of fire fighting equipment. Columns on which the fire hose stations are located are painted a brilliant red. Merely by opening the valve of the hose station, an alarm is automatically transmitted to the fire department. Numerous fire alarm and watchman's boxes are located at strategic points, so regulated that the watchmen on the "cat-walks" alternate their rounds with those on the floors. Thus constant supervision is maintained.

The greatest fire hazards are the paint buildings, which are equipped with a heat responsive system that detects the presence of fire almost instantaneously, and activates a withholding valve, allowing water to enter a piping system of suprotex deluge sprinklers. These systems apply water over the whole area vertically, thus there are no horizontal obstructions that are ordinarily encountered in the use of hose streams. About one quart of water per minute is discharged to each square foot of floor space. This water is discharged under high pressure and is atomized into fine particles which have a relatively high factor of heat absorption and greatly obstruct the supply of fresh oxygen.

Automatic Damper Controls in Dope Room

In the "dope room" of the paint building, a hydro-pneumatic device is attached to the suprotex deluge valves which, when they operate automatically, close three large fire dampers installed in the air conditioning ducts, thus shutting off the fanning effect of fresh air into the room. An ingenious mechanism attached to the heat actuated device system is automatically operated by water, and pumps a pressure of 16 ounces into the heat actuated device system. When the device is unable to maintain the 16 ounces of pressure, an alarm is sounded, which indicates trouble or possibly a rupture in the system or that someone is tampering with the system.

Fire protection piping is kept separate from the domestic water piping and a stabilizer pump maintains 90 to 100 psi pressure on the fire lines at all times. If the pressure should drop low because of the operation of one of the suprotex deluge valves, two 1500 gpm fire pumps will automatically start and will deliver the water slightly in excess of 100 psi.

One-half million gallons of water is stored in the surface reservoir. The fire pumps are located below the normal level of the reservoir to keep them under constant prime. If the pumps fail, an auxiliary source of 100,000 gal from the gravity tank will automatically be available.

Complete Sewage Treatment Plant

A complete sewage treatment plant, employing an activated sludge process, was built on an inclined site approximately 1200 feet from the Assembly Building. Gravity flow of the sewage is maintained throughout the collective system. The plant was designed on the basis of 30 gpc (gal per capita) per eight-hour shift, or 90 gpcd (gal per capita per day) with a peak flow of 2.5 times the average flow.

Problems in Building a Power House on the Bank of the Ohio River

Pittsburgh Plate Glass Co., Columbia Chemical Division, built power plant near New Martinsville, W. Va., on soil that presented unusual problems . . . Pumping expense a factor in choice of location . . . Rise and fall in river level provided for in plant structure . . . Coal handling and storage peculiar to river-bank location . . . Principal power generating equipment is listed

By W. H. HARTMAN
Chief Draftsman, New Martinsville Plant
Columbia Chemical Division, Pittsburgh Plate Glass Co.

AS PART of the chlorine plant located on the West Virginia side of the Ohio River, eight miles up the river from New Martinsville, this power house was engineered and designed by the Pittsburgh Plate Glass Company, Columbia Chemical Division.

An engineering study indicated that it was more economical to put the power house on the river bank than to locate it back from the river on high ground. The large amount of water to be pumped and the handling of all the coal via river barges were the factors primarily influencing this decision. Similar practice is followed by public utility companies in their power stations along this part of the Ohio River.

The Ohio River at the plant site is normally maintained at navigable depth by Lock No. 15, located at New Martinsville, which is elevation 602 ft. The river, however, responds rapidly to abnormal rainfall in the upper watershed, and consequently for eight months out of the year the water level fluctuates 8 to 20 ft and with a spring freshet of about 33 ft rise. Then there are the periods of abnormal floods when the river will rise about 40 ft above normal. In the 1913 flood the river reached elevation 646 ft or 43 ft above the normal river. On January 1, 1943, the river reached elevation 644.6 ft. This flood gave cause for some concern, since it came while the power house was under construction. The work had not advanced sufficiently, however, to be harmed by high water. There are also times, especially in the spring of the year, when the dam wickets are dropped in order to clear the area above the dam from floating ice. This action generally lowers the water 4 to 6 ft below normal.

River Bank Soil

The power house is so located on a bend in the river that the main current sweeps the opposite shore. The foundation soil is sand and clayed silt of varying fineness carried there by water action in years past, and extends down to the rock, which is at elevation 573 ft, or a depth of 60 ft below natural ground level. This is the material that must support the power house, coal storage, and coal handling system.

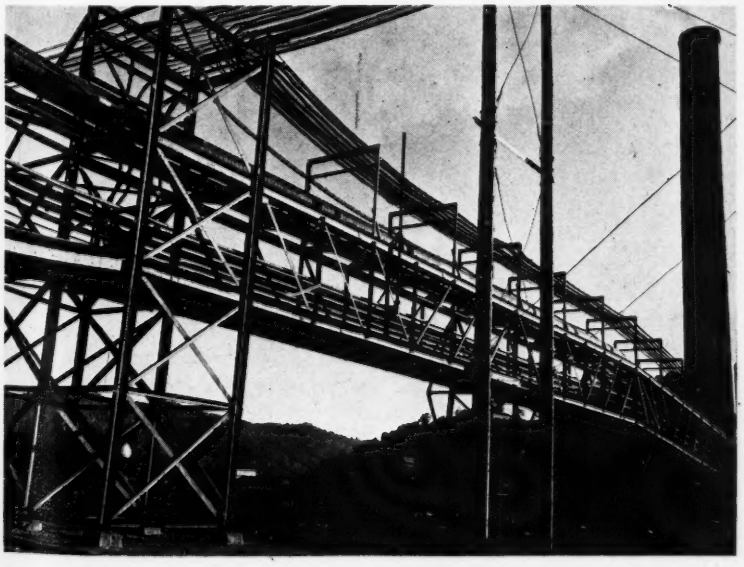


Fig. 1. (Above) At the Columbia Chemical Division plant of the Pittsburgh Plate Glass Co., coal is delivered by barges and is unloaded by means of a crane. Construction of the foundation for the crane was one of the most difficult phases of the job

Fig. 2. (Left) The power house is linked with the manufacturing area of the plant by means of a steel and timber bridge which serves to carry electric cables and piping as well as a walkway across the railroad tracks

*All photographs reproduced for use with this article were taken by Gottscho-Schleisner, 150-35 86th Ave., Jamaica, New York, and released by the Defense Plant Corp. and the Bureau of Public Relations War Department.

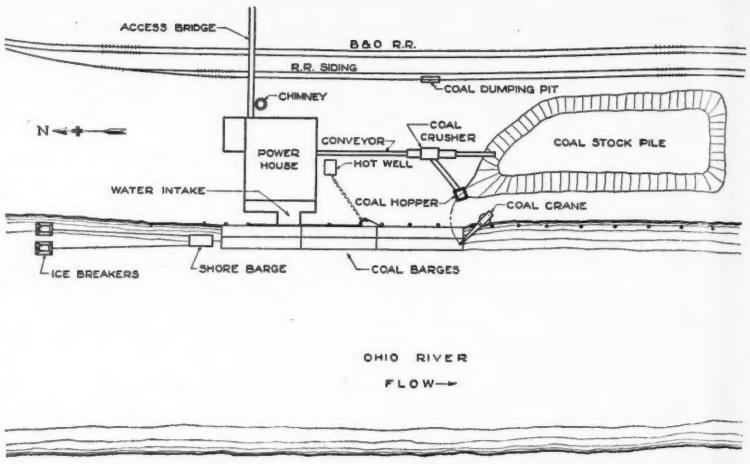


Fig. 3. Relative location of power house, coal pile, railroad and river constituting the power generating facilities of the Pittsburgh Plate Glass Co. plant at New Martinsville, W. Va.

The power house is so designed that during flood stage of water rise of 43 ft (elevation 646 ft), and sub-normal river water level, as a result of dropping of dam wickets, that there will be no interruption of operations or reduction in capacity. To accomplish this objective it was necessary to provide an access bridge, coal storage, coal and ash handling system, all accessible and operative above the high water level.

In order to meet the conditions of high flood stage water and still be low enough with the power house to assure economical condenser water pumping costs, it was decided to set the power house down to favor the pumping and use massive concrete water-tight construction up to flood stage level of elevation 646 ft. This divided our construction problems into two classes: First, to get the structure sufficiently heavy to prevent floating during high water and second, to secure sufficient foundation supports for structure at low river level, or when no buoyancy is effected.

Foundation Construction

For foundations, we were not allowed to use steel for caissons, and displacement piles to rock could not be used since they would destroy the natural bearing value of the soil if driven at the very close spacing that was obviously required. Weight loading of the structure was necessary to keep it from floating during high water. The water intake had to be carried to rock in order to get sufficient depth to assure pumping water when the river is 4 to 6 ft below normal.

We were permitted to make use of used steel sheet piling, if available, and as a certain amount of sheet piling was needed to construct the water intake, it was decided to use steel sheet piling to confine the soil and design the structure as soil bearing.

The water intake end of the structure was carried down to rock by means of large sections of concrete caissons. These served to confine the soil on the river end of structure and steel sheet piling was driven on the three remaining sides of the power house to within 15 ft of rock. A sliding joint was provided in the piling and concrete caissons to allow for differential settlement of the structure set on confined soil.

In order to distribute the loading for confined soil bearing and also to secure the necessary weight to prevent uplift during flood-water stage, a reinforced base slab, 6 ft thick, was used under the structure. The average soil pressure under the base slab is under a pressure of 3000 lb per sq ft and was considered safe. Results after 8 mo of operation show no settlement.

A brick chimney 16 ft inside diameter by 225 ft high, weighing about 1000 tons, was similarly supported on confined soil by using steel sheet piling driven on a 38-ft dia circle down to within 22 ft of rock and concrete capped to form the stack base.

A large revolving crane fitted with an 8 cu yd clam-shell bucket for use in unloading coal barges and for delivering coal to a conveying system to the power house or to storage, is similarly supported, except that instead of steel sheet piling, a concrete cylindrical caisson, 34 ft in diameter, was sunk by use of a 1½ yd clam-shell bucket to remove sand and silt from the inside until the caisson was within 7 ft of rock. The cais-

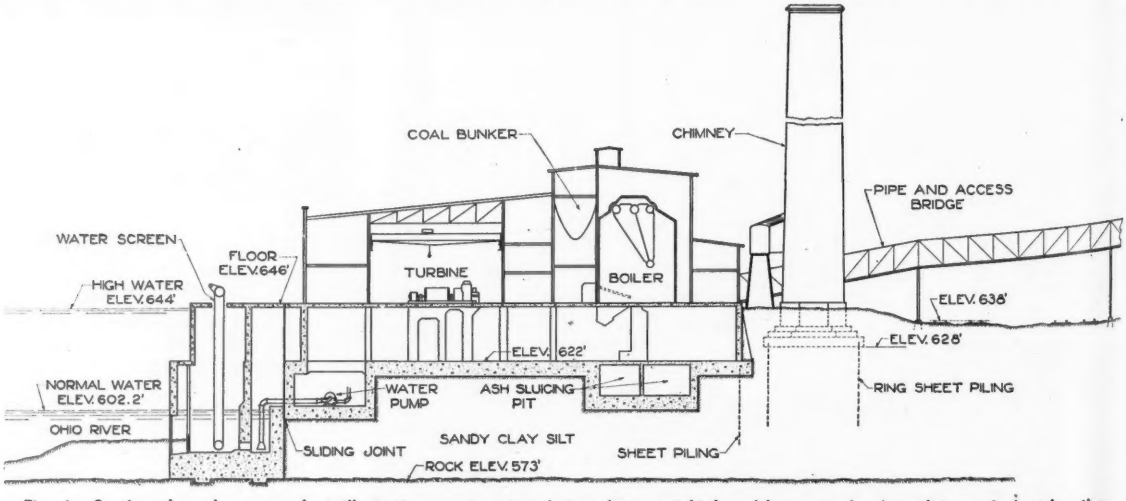


Fig. 4. Section through power plant illustrating construction designed to meet high and low water level conditions of plant location

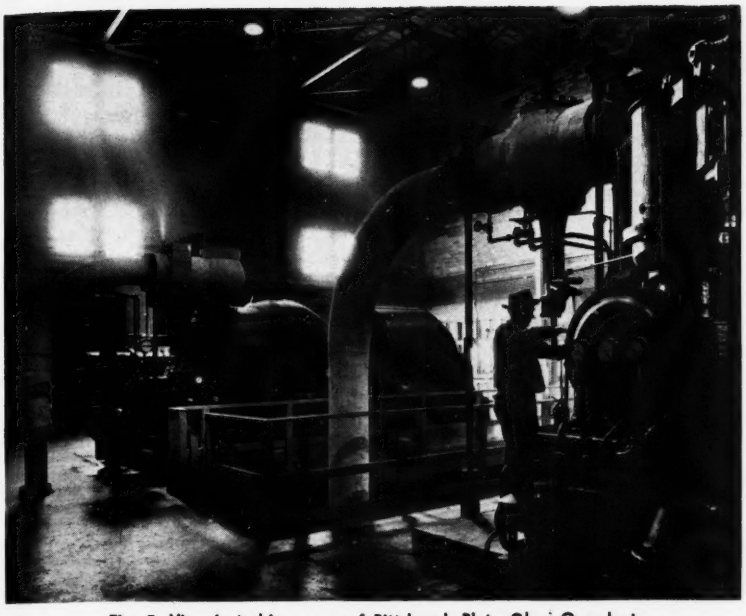


Fig. 5. View in turbine room of Pittsburgh Plate Glass Co. plant

veying system to the boiler bunkers, an auxiliary railroad track dump pocket, and an open coal storage pile. Since the coal handling is to be operative during river flood stage, the loading hoppers, crusher house, and conveyor junctions were designed as concrete water-tight enclosed pits when they were lower than elevation 646 ft. Also, constructions were made massive to secure necessary weight to prevent uplifting during high water.

The bulk storage capacity is about 50,000 tons, 30,000 tons of this is above flood water level and therefore available during that time.

Bulldozers and earth movers are used to transport coal over the storage area. Recovery is effected by discharging over a feed hopper with conveyor to the crusher house.

The coal crane when unloading

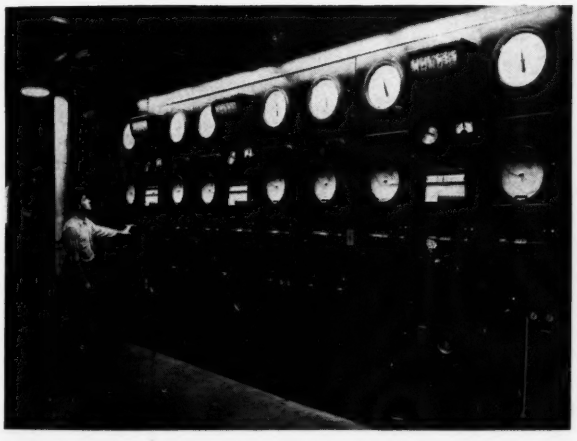


Fig. 6. Power house panel board which gives information on performance of equipment throughout the plant

Fig. 7. Rectifier room where mercury arc rectifiers convert alternating into direct current used in the separation of chlorine gas from malt brine

son was then filled with compacted sand for a height of 26 ft, and the entire top capped with a reinforced concrete slab. A cylindrical piece was then continued up to elevation 646 ft and a crane mounted thereon. This height assures the crane of always being above maximum flood stage.

In this support design the concrete capping of caisson confines the fill within the caisson and produces a confined soil bearing at a point 7 ft above rock. The caisson was not carried to rock since to do so would require divers and underwater concreting. As constructed, no under-water work was necessary except for excavation in the caisson with the clam-shell bucket.

Coal Storage

The coal-handling system consists of a crusher house, a con-

Fig. 8. Pumps in the power house used to supply water from the Ohio River for power generation and industrial purpose. Heavy concrete columns and beams are noteworthy construction features

Principal Equipment—General Specifications, Manufacturers and Suppliers

CONSTRUCTORS: The H. K. Ferguson Co., Industrial Engineers and Builders.

BOILERS: 3—B. & W. Stirling boilers with superheaters and air heaters. Capacity 180,000 lb each, 900 psi, 750 F. —The Babcock & Wilcox Co.

ECONOMIZERS: Fin tube economizers. —The Superheater Co.

AIR PREHEATERS: Cast-iron 72 in. Vento heater stacks.—American Blower Corp.

STOKERS: Water cooled 13 retort Taylor stoker with clinker grinders and Hele-Shaw pump hydraulic drives.—American Engineering Co.

FANS: Forced draft fan—No. 9 double inlet, double width American H. S. Induced draft fan—No. 8½ double inlet, ⅔ double width Siroco.—American Blower Corp.

FAN DRIVES: Geared steam turbines, 175 psi steam, 30 psi back pressure.—Worthington Pump & Machinery Corp.

SOOT BLOWERS: 6—Units Type IH 90, 900 psi steam; 10—Units Fixed Type, 175 psi steam.—Diamond Power Specialty Corp.

CHIMNEY: 16 x 225 ft red radial brick chimney.—Alphonse Custodis Chimney Co.

BOILER CONTROL: Boiler, stoker, steam pressure and water level control and panel board. Meters—Bailey Meter Co. Control—Leeds-Northrup Co.

BOILER FEED PUMPS: No. 4 HMT 7 stage centrifugal pump driven by 825 hp Worthington 10 stage steam turbine, 175 psi steam, 30 psi back pressure.—Ingersoll-Rand Co.

BOILER WATER TREATMENT: Cochrane Corp. hot process lime and soda treatment plant.—Dravo Corp.

ASH HANDLING: Hydraulic ash sluicing and dust removal system.—Allen-Sherman-Hoff Co.

COAL SCALES AND DISTRIBUTORS: 6—Seco automatic scales; 3—coal distributing hoppers.—Stock Engineering Co.

COAL CRANE: 1—No. 5 W Bucyrus Monighan revolving crane with 7½ cu yd bucket.—Bucyrus-Monighan Co.

COAL HANDLING: Belt conveyors, belt scales and trippers. Capacity 250 tons per hr.—Continental Gin Co.

COAL CRUSHERS: 1—Williams No. 4 Slugger Type Ring Roll Crusher.—Williams Patent Crusher and Pulverizer Co.

COAL SAMPLER: Motor driven Sampler for attaching to inclined chute.—Stephens-Adamson Mfg. Co.

HIGH PRESSURE VALVES:—Wm. Powell Co.

HIGH PRESSURE PIPING:—Pittsburgh Piping and Equipment Co.

AIR COMPRESSORS: 2—500 cu ft 110 psi pressure two-stage air compressors V-belt motor driven.—Worthington Pump & Machinery Corp.

TURBINE GENERATORS: 1—1500 kw Westinghouse (used) turbine generator. 175 psi steam, 30 psi back pressure, generator, 2300 v, water cooled recirculating air.—Westinghouse Electric & Mfg. Co. . . . . 1—7500 kw General Electric (used) condensing turbine generator, 175 psi steam. Generator 13,800 v washed air cooled.—General Electric Co. . . . . 1—10,000 kw General Electric (used) condensing turbine generator, 175 psi steam. Generator 12,000 v washed air cooled.—General Electric Co. . . . . 2—7500 kw Westinghouse turbine generator. 900 psi steam, 175 psi back pressure, generator 13,800 v, water cooled recirculating air cooled.—Westinghouse Electric & Mfg. Co.

CONDENSING WATER PUMPS: 2—24-in. NFV centrifugal pumps, motor driven.—Ingersoll-Rand Co. . . . . 1—24-in. Worthington (used) centrifugal pump, steam turbine drive. 175 psi steam 10 psi back pressure.—Worthington Pump & Machinery Corp.

WATER SCREENS: 3—8 ft wide by 64 ft centers traveling intake water screens ⅜-in. square openings.—Chain Belt Co.

TURBINE ROOM CRANE: 40 ton traveling crane 53-ft 8-in. span.—Whiting Corp.

ELECTRIC SWITCH GEAR: Westinghouse Type B28B oil circuit breakers, remote controlled on panel.—Westinghouse Electric & Mfg. Co.

TRANSFORMERS: All 3 phase, 60 cycle, oil cooled. 2—750 kva 2300/440 v, 1—5000 kva 13,800/2300 v, 1—12,500 kva 12,000/13,800 v.—Pennsylvania Transformer Co.

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coal from barges can deliver coal to the feed hopper of the conveyor to the crusher house or direct to the storage area for bulldozer distribution. Or coal can be delivered to the crusher house and then discharged to the belt conveyor direct to the bunkers or to an auxiliary belt conveyor to the storage area for bulldozer distribution. An automatic weigh scales is located on the belt conveyor from the feed hopper to the coal crusher, so that coal can be weighed as received and serve as a check on barge weights.

The river area in front of the power house is dredged to have 12 ft normal depth. Two large ice breakers were installed up the river from the barge-unloading area. These also serve as anchors for heavy cables leading to a shore barge for use in securing coal barges at the site for unloading. Space has been provided for handling six 900-ton loaded barges at one time.

The ice breakers, so named as they tend to break up ice flows that may endanger security of the barges tied up at the plant, in reality are anchor posts sufficiently high and strong enough that barges, tow boats, etc., can be secured thereto with safety during flood stages. These ice breakers were constructed of timber cribbing below low water, mass concrete filled, and extension above the water, reinforced concrete sand filled. The top of the ice breakers is 41 ft above normal water and is provided with red warning light.

A shore barge is secured to the ice breakers with two 2-in. steel hawsers. This shore barge serves as a means of securing coal barges to the ice breakers as the shore barge raises and lowers with the water and carries the ends of the steel hawsers with it.

In the power house and coal-handling structures, reinforced concrete was used wherever possible to save steel. Conveyor galleries were made from used ones by placing the conveyor belt within the housing and an access walk on the outside, on cantilever construction.

Building walls are of concrete blocks set self-supporting on the foundation and stayed to the steel structure. This construction permits walls to be blown away from the building without injury to the structure, in case of internal explosion.

In the power plant are three 900-psi boilers, two 900 to 175-psi topping turbines, two 175-psi condensing turbines (used), and one 175 to 15-psi turbine (used).

The used turbines presented a problem, as equipment available was old, repairs difficult to get, records not complete, and performance anticipations of doubtful value. In face of all these, however, their performance to date has been more than pleasing.

Now that the plant is running and our construction problems are over, we are glad to have had the experiences of meeting what seemed to be unreasonable and absurd limitations.

AMONG THE HELPFUL PUBLICATIONS recently issued by the National Bureau of Standards is Circular C447 which summarizes the results of a comprehensive survey of the technical literature on the strength and related properties, thermal expansion, and thermal and electrical conductivities of ferrous and nonferrous metals and alloys at normal, high and low temperatures. In general the data are presented in tabular form, although graphical representation is used in many cases to indicate the effects of changing composition or conditions on the properties. Data on aluminum, copper, iron and steel, lead, magnesium, nickel, tin, zinc, and a number of miscellaneous metals and their alloys are included. This circular, which replaces C101 and supplement, is not limited to conventional engineering materials but contains data on the properties of many materials which are not usually classed as such.

Guarding Grand Coulee Against Fire

Carbon dioxide fire extinguishing systems guard electric generating units, switchyard oil house and oil systems . . . Built-in units for generators are designed for automatic as well as manual operation . . . Operating principles described

By D. A. DIEHL*

ENGINEERS at Grand Coulee power plant, which will some day be the world's greatest single source of electricity, have just about completed installation of carbon dioxide fire extinguishing systems for protection of six 108,000 kva, two 75,000 kva generators, two 12,500 kva station service units, a 230 kv switchyard oil house, an oil purifier and oil storage room. When completed, the carbon dioxide fire protection systems for the generators in the west power house at Grand Coulee will include a total of 125 50-lb size system cylinders, with a number of hand and wheeled type portable carbon dioxide units for smaller equipment.

As specified by the Bureau of Reclamation engineers, who ordered the work, the entire Grand Coulee installation complies with the appropriate regulations of the National Board of Fire Underwriters, the Bureau of Explosive Regulations, and the Interstate Commerce Commission.

At Grand Coulee, the systems protecting the generators are allocated as follows. One 29-cylinder system, with 24 cylinders for initial discharge of carbon dioxide with a separate pipe line and nozzles, to build up rapidly the proper fire extinguishing concentration, and five cylinders with a separate smaller pipe line and nozzles for delayed discharge of carbon dioxide, to compensate for concentration leakage, protects 108,000 kva units L-1, L-2, and L-3. An identical system is allocated to generators L-4, L-5, and L-6, also 108,000 kva units. Units L-7 and L-8, of 75,000 kva capacity each, are assigned a battery of 32 cylinders, 8 of which are for delayed discharge. Each of the 12,500 kva station service generators has a battery of three cylinders, one of which is for delayed discharge.

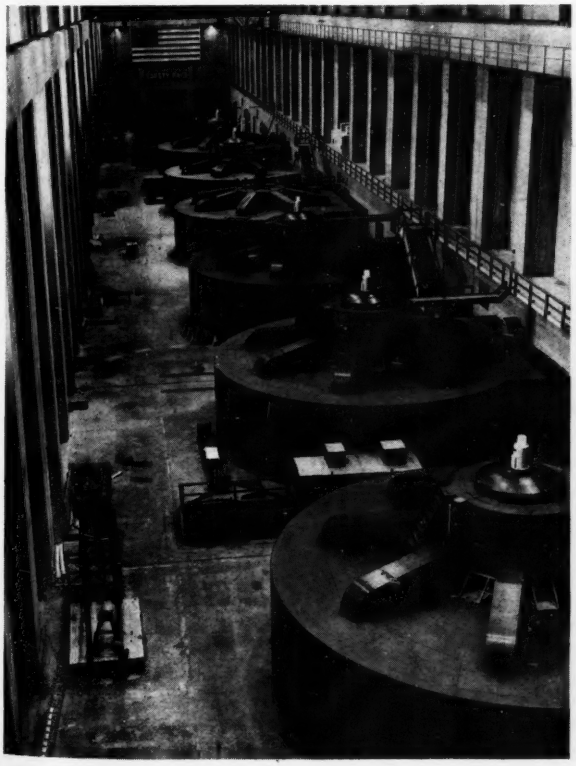
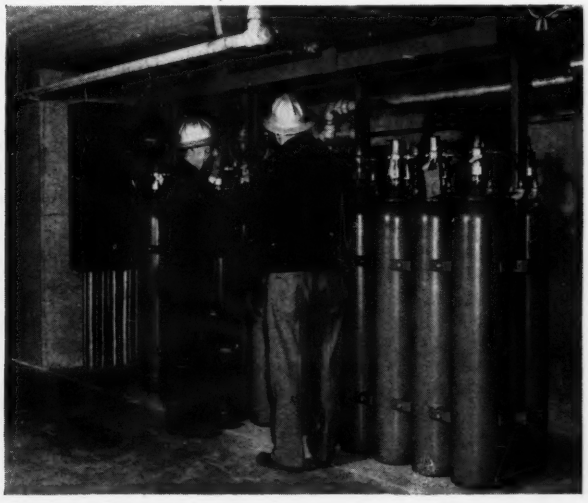


Fig. 1. (Left) View of generator room at Grand Coulee

Fig. 2. (Below) Bank of carbon dioxide cylinders serving three 108,000 kw generators. Control cabinet for electrical fires shown at left



Built-in Systems for Generators

All of the systems for the generators are of the built-in type and are designed for automatic as well as manual operation. Discharge nozzles of the initial and delayed discharge pipe lines are located inside each generator. Carbon dioxide from all cylinders for delayed discharge is released at the discretion of the station operators and as required, to maintain a sufficient quantity of carbon dioxide gas in the unit during deceleration of the rotor and for a period long enough to assure complete extinguishment of all glowing or smoldering material. Selector valves in all systems protecting more than one unit automatically or manually direct the gas into the unit affected.

The discharge nozzles are of the baffle type and are fixed in the generator air passages in varying numbers and spaced in accordance with the requirements for the most effective discharge of the initial and the delayed discharge lines in each type generator. The rapidity of discharge is controlled by the size of the nozzle outlets; carbon dioxide for initial concentration is rapidly discharged using large orifice nozzles, while carbon dioxide for delayed discharge is restricted to a slow and continuous discharge by using a small orifice nozzle. In the eight large units, the initial and delayed lines are each allotted eight nozzles and in the station service unit there are four nozzles in the initial and two in the delayed line.

Piping for the larger units is of

*Equipment Department, C-O-Two Equipment. Co.

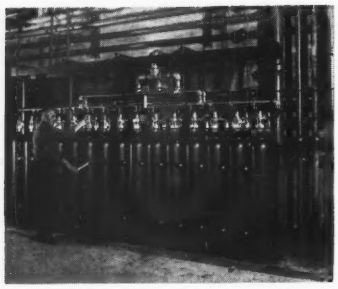


Fig. 3. Carbon dioxide cylinder bank and discharge piping for fire protection of the oil storage room in the west power house at Grand Coulee Dam

Fig. 4. Type of station service fire trucks mounted with two 50-lb carbon dioxide cylinders, used at Grand Coulee

2-in. size for the initial discharge, ¾-in. for the delayed. For the station service units, ½-in. pipe is used for each line. The piping systems from the cylinders to the manifolds are of a size which provides for complete discharge of a cylinder to atmospheric pressure in one minute or less.

Each cylinder has a normal capacity of 50 lb of carbon dioxide.

The valve on each cylinder is of the type which allows for refilling. It is fitted with a recoil preventor and a separate safety and pressure relief disc. Simplified maintenance of valves and cylinders is provided by an arrangement which includes a weighing device that makes it possible to weigh the cylinders without removing them from their places in the bank. Each cylinder valve has a separate discharge head; a ball check in the head prevents loss of gas from a system operation, in case any discharge head is disconnected from its cylinder during periodic inspection.

Sequence of Operation

Automatic actuation of the systems is accomplished by operation of the differential relays or by means of thermostats of the fixed temperature type located in the recirculating air passages of each generator and they operate at a temperature of 185 F. When the temperature in the generator reaches the operating degree of the thermostat, the circuit is closed and current is applied to electric discharge plugs in the discharge heads of two control cylinders and in the automatic selector valves.

The plugs contain a small powder charge which is ignited by burning of a small fuse wire within the plug. The pressure thus provided is sufficient to drive the piston and cutter assembly of the discharge head downward to puncture the sealing discs of the two control cylinders in each group of cylinders. In the same way, pressure is provided for opening of the selector valves. Carbon dioxide pressure from these control cylinders operates the discharge heads of all other cylinders in the battery.

After the main battery has been discharged, additional cylinders are arranged for manual release in sets of two or three cylinders, as required. The discharge heads of the control cylinders are equipped with quickly detachable protection covers which, when removed, allow for local manual operation. Operation of the electric discharge plugs automatically opens the electrical circuit and prevents draining of the current supply.

When the system is actuated automatically or manually from the manual station, a red lamp is lighted on the system control cabinet and on the manual control box. An annunciator window is lighted at the unit control board and at the main control board, and alarms are sounded at the generator and in the main control room.

In the 108,000 kva units, the rotor is 30 ft in diameter. All automatic initiating devices, and the manual station operate on a 250 v d-c circuit. Only the application of current to the discharge plugs, or manual operation, can cause these systems to function and they do not depend on the function of a single electric release for successful operation.

Switchyard Oil House Protection

Protection for the two-story 230 kv switchyard oil house is provided by twenty 50-lb cylinders of carbon dioxide manifolded together and mounted in a separate room on the second floor next to the oil filter room. Two pilot cylinders in the battery have electric discharge plugs for automatic operation and quickly detachable covers allow for local manual operation.

The oil filter room and the oil room, directly below it on the first floor, are protected by a 20-cylinder system. Seven baffle type nozzles on the walls of the oil filter room and ten in the oil room are located above the floor and so spaced as to give most effective distribution of the carbon dioxide for total flooding of the rooms. Two thermostats are required for the oil filter room and three for the oil room. All are placed on the ceilings.

The two rooms are connected by an open stairway, and, in addition to three 6600-gal oil storage tanks, the oil room houses a motor-driven oil transfer pump. A motor-driven oil purifier of the combination centrifuge and filter-press type is housed in the oil filter room.

The system protecting the oil purifier and storage room consists of forty-two 50-lb cylinders mounted outside the protected space. Two discharge heads of the control cylinders are fitted with quickly detachable covers to provide local manual operation. These heads are also fitted with electric discharge plugs for remote manual electric operation from a break-glass control box located just outside the protected space or for automatic release on operation of any thermostat. Total flooding of the room is provided by twenty-six baffle type nozzles spaced around the walls and a ⅛-in. sealed strainer type nozzle is fitted into the top of each of four oil storage tanks in the room. Two large tanks each hold 17,000 gal of oil, in addition to two smaller tanks each holding 5000 gal of oil.

AT A MEETING of the American Society for Testing Materials committee on corrosion of iron and steel held recently in Cincinnati, it was reported that careful reviews were made by the committee of its numerous specifications, most of which are to remain unchanged for inclusion in the 1944 Book of ASTM Standards. Among these specifications are some dealing with the protection of wire and sheets for various uses by means of zinc coating. The committee also gave an interesting outline of field conformance to tests, one of the objectives being eventually to be able to correlate laboratory and field tests. This is a most perplexing and involved problem, but progress is anticipated. A magnetic test of coating, it is hoped, can be recommended as a field test and a continuity test which may be based on the so-called Hermance procedure is being evaluated which, however, would probably not fulfill the requirements of a field test.

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

Wanted, More Dope on Small Plants

In a letter presented under the "Letters and Comments" section of this issue, one of our good subscribers mildly criticizes us for running too much material on large plants. A large share of the plant descriptions, he points out, are of stations with huge boilers and turbines where they kick a hundred thousand kilowatts around like nobody's business. While such plants are of passing interest they do not help him in his work. He feels that there are a great many more small plants and that the majority of readers of POWER PLANT ENGINEERING want information on such small plants.

Mr. Green is perfectly right. We do publish a great deal of material about large plants but we do not do this because of our own choosing. If we could get material on small plants equally as good as that which we present on large plants, we would be only too happy to publish it. The fact is, interesting articles dealing with small plants are difficult to get. Most of the small plants are old plants with no particularly outstanding features and unless articles about such plants deal with operation there is little that one can say about them.

Of course, we are always interested in getting articles on operation but in this we are up against the fact that the average engineer in the small plant is not addicted to writing. Even if he has worked out operating or maintenance procedure that would be of interest to fellow engineers, he is reluctant, or feels incapable of expressing himself on paper. In many cases he lacks the necessary enthusiasm to write an interesting article.

Needless to say, we are always eager to secure articles dealing with the problems of the small plant operator and if any of the readers have anything to offer, either in the way of small plant descriptions or good operating stories, we urge them to send them in. They will receive our earnest consideration.

Such material need not be written in the best of English. All we need are the facts. Don't worry about the grammar; we will do the polishing. That, after all, is our business.

A.W.K.

CONTENTS

The Park Avenue Noise Mystery 92
By Andrew W. Kramer

Phos-Copper Brazing of Armature Coils 96
By C. Lynn

Practical Hints and Kinks 99
Electronic Motor Drive for Drill Press
Fluting Pipe in an Emergency
By J. R. Kennedy
Overcoming Water Seepage
By G. F. Suchy
Direct Temperature Readings in Coal Piles
By C. C. Butterworth

Catpower 100

Letters and Comments 101
A Plea from the Small Plant Operator
The Life of a Maintenance Man in a Hospital

Repairing a Broken Anchor Bolt 102

Questions and Answers 108
What Do You Do About Goggles, Boiler Suits, Respirators, CO Alarms?
How Determine Correct Suction Pressure on CO_2 Machine?
What Causes Locking of Wound-rotor Motor Converted to Compensator Starting?
Why Install a By-Pass Around a Pump Governor?
How Can Boiler Operation Be Improved?
Why Do Slag Screen Tubes Fail in Only One Boiler?
How Stop Fuel Waste in This Unit Heater System?
Would 220-v Motor Be Harmed by Connecting to 110-v Circuit?

Chimney Performance Chart 114

A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE
Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

The Park Avenue Noise Mystery

The first published account of an unexpected but interesting effect of a fan installation in New York City in 1938. It caused considerable commotion on Park Avenue but the solution was finally effected nearby on Third Avenue as disclosed in this article

By ANDREW W. KRAMER

EVERY ONCE in a while in this business we call engineering one runs into a problem that provides all the elements of a good mystery story. First, there is the mystery, usually in the form of some unexpected headache; a piece of equipment begins to behave queerly—an ice machine gets red hot or a heater becomes covered with frost, fuses begin to blow for no reason at all. Sometimes a furnace decides to turn inside out. These things, naturally, require investigation and so the Hawkshaws and the Sherlock Holmes appear on the scene. Theories fly thick and fast, hypotheses are weighed and tested, strange men with strange-looking instruments and gadgets roam around at large. All the while there is excitement, much tearing of hair, harsh words, furious correspondence and telephoning and damning of things in general. Finally, comes the solution; the cause of the trouble is found, sometimes as the result of clever scientific sleuthing, more often by sheer good luck, but in any case, all is serene afterwards and everybody's worries are over.

The case we are about to relate occurred up on Third Avenue in New York City, but for reasons which will become apparent presently, we prefer to call it The Park Avenue Noise Mystery —it sounds swankier. To get back to Third Avenue, however, those who upon occasion travel on the Third Avenue Elevated may recall that when the train reaches the 90's there comes into view on the east side of the street an imposing group of buildings, through the windows of one can be seen a row of huge, shiny, copper kettles. They cannot fail to catch your eye. On a balmy summer's evening a delicate, malty bouquet pervades the atmosphere in this region because it is here that the great plant of the Jacob Ruppert Brewery Co. is located.

Our story begins at this point, at 1639 Third Avenue, New York City, in the summer of 1938. It was about that time that the finishing touches were being applied to a fine new power plant which the Ruppert Brewing Co. had been installing. For many years Ruppert's had produced their own power but at this time as a part of a general expansion and improvement program, the old boilers and engines were being retired and a new medium pressure boiler plant and turbogenerators installed instead. The boilers were modern units of latest design, served by both forced and induced draft fans. The engineering was of the highest order.

The new plant slipped into service, easily and without fanfare or excitement, and without the smashing of so much as a single bottle of Ruppert's Ale at the opening ceremonies. This does not mean that bottles were not opened. Everything worked fine and everybody was pleased.

During the following months, however, at certain times a disturbing noise seemed to emanate from the area around the two induced draft fans. These fans were installed on a structural steel platform as shown in the accompanying drawing and were connected in parallel. They were standard, double-inlet, full housed, vertical, down-discharge induced draft fans driven through hydraulic couplings by 100 hp constant speed (870 rpm) induction motors. The two fans were identical.

The noise, it was quite evident, emanated from the fans or the connected duct work but it appeared only at certain times. There were periods when there was no more noise than ordinarily arises from the operation of induced draft fans.

About this time a rather strange thing happened. Residents as far away as Park Avenue—several blocks away —began to complain of a very disturbing noise, a low pulsating type of noise. From the first it was quite evident that the Ruppert plant was causing this noise and investigations were begun. In the early rumors it was reported that windows were broken but these rumors were proved unfounded; the noise, however,

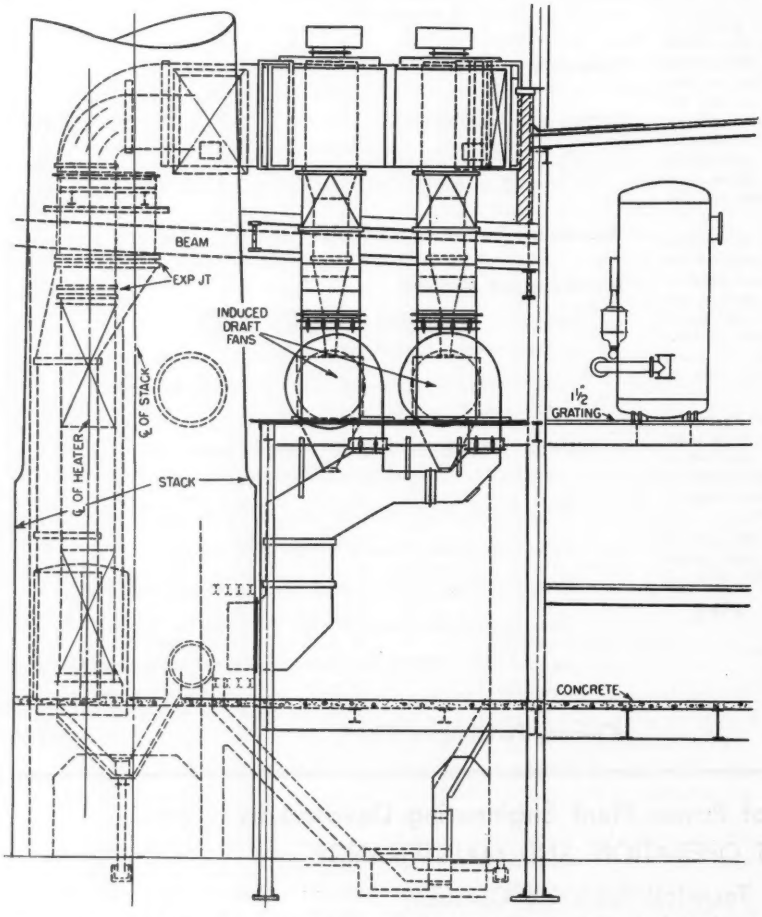


Fig. 1. Details of the induced draft fan installation at the plant of the Jacob Ruppert Brewing Co.

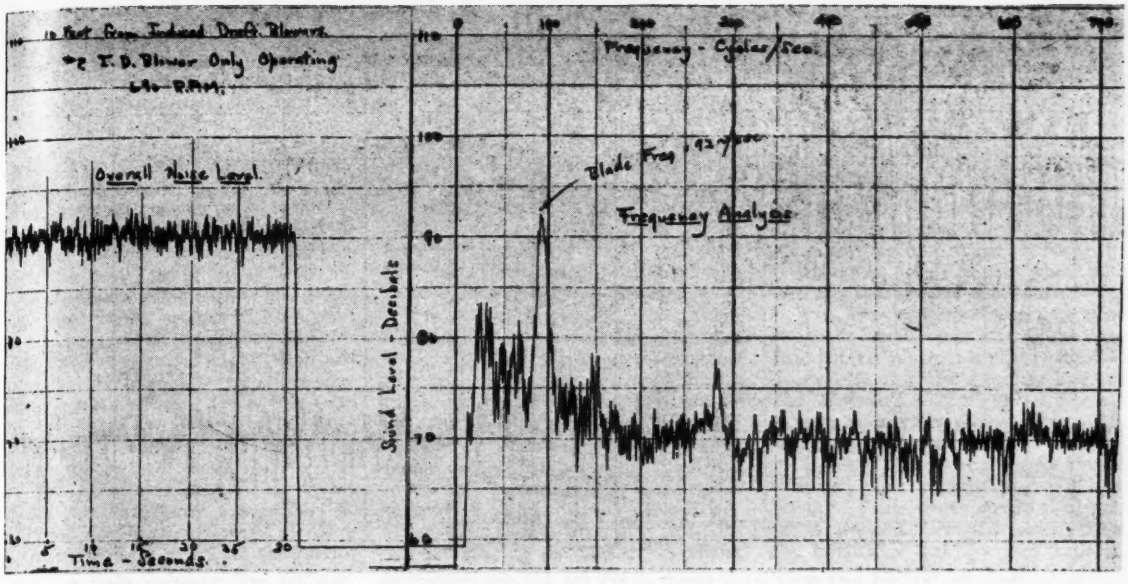


Fig. 2. Graphic record showing the overall noise level of a single induced draft fan at the left and at the right, its frequency composition

was decidedly disturbing and annoying.

It was clear that the fans were causing the trouble but at first it was not certain whether the sound was radiated from the fans or from the ductwork or breeching on the roof of the plant. The noise which caused the nuisance was a very elusive phenomena, in fact at some times it could hardly be called a noise; it was more of a beat which was felt rather than heard, and which varied in intensity and frequency. At times it was almost inperceptible at the plant though, perhaps, strong at some point distant from the plant. The very elusiveness of the phenomena caused many suggestions to be made, all of which were carefully reviewed and some of which would have been expensive to carry out.

The consulting engineers started a series of tests which indicated clearly that the trouble was a result, direct or indirect, of fan operation but did not occur at all times with two fans in service. This was particularly true if two fans were in service in perfect synchronism with each other. However, it later developed that something more than perfect synchronism was needed and that was that perfect synchronism plus a blade position in the fan casing exactly alike were needed in order to entirely eliminate the noise. Also, there were times when the two fans were operating at widely varying speeds when the noise was imperceptible.

Obviously in order to have the fans at maximum effectiveness it was necessary that they operate at substantially the same speed but exact locked synchronism both as to speed and blade position was difficult.

After these facts had been developed and considerable other data had been accumulated the engineers decided that it would be desirable to make actual measurements of the phenomena and as a result the consulting engineers called in the Electrical Research Products, Inc., to work in conjunction with them and make further tests and measurements with the instruments available to this outside organization. Preliminary observations by the engineers of this company substantiated the findings that the disturbance was the result of both fans operating simultaneously.

This furnished the clue as to what was happening. The low frequency variation in intensity of the noise when both fans were running suggested the presence of a resultant beat frequency between components of the noise of each

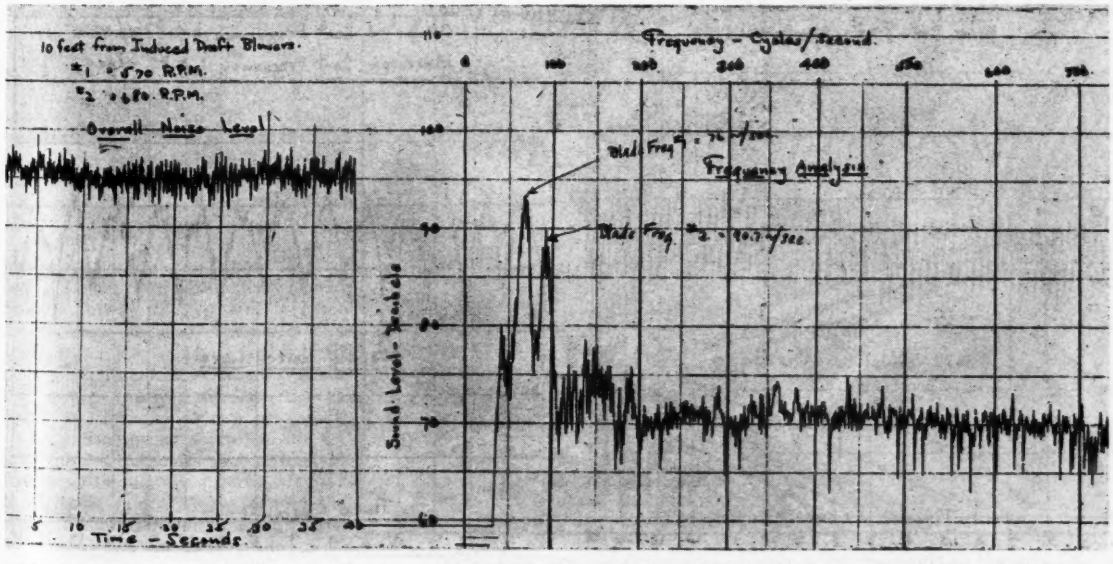


Fig. 3. Record similar to that shown in Fig. 2 but with two fans operating simultaneously at speeds of 570 and 680 rpm, respectively

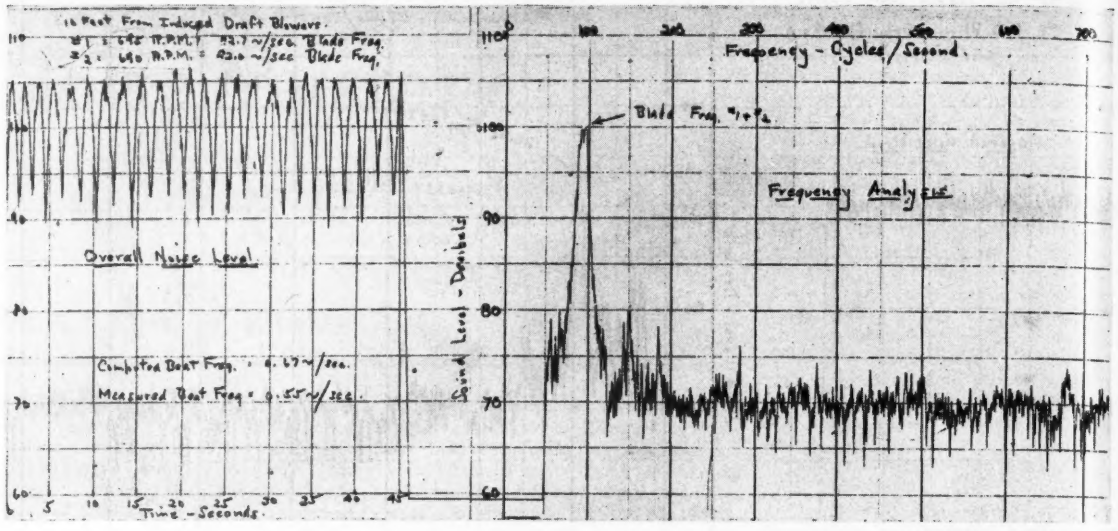

10 Feet From Induced Draft Blowers.
#1 = 695 R.P.M. = 92.7 ~/sec. Blade Freq.
#2 = 690 R.P.M. = 92.0 ~/sec. Blade Freq.
Overall Noise Level
Computed Beat Freq. = 0.67 ~/sec.
Measured Beat Freq. = 0.55 ~/sec.
Time - Seconds
Sound Level - Decibels
Frequency - Cycles/Second
Blade Freq. #1+#2
Frequency Analysis

Fig. 4. Here, the two fans were operating at speeds of 695 and 690 rpm, respectively. Note the beat frequency effect in the chart showing the overall noise at the left

blower when operating simultaneously at substantially equal speeds. In other words, the frequencies set up by the fan blades were beating against each other so as to set up a resultant noise frequency which was equal to the difference between the respective fan blade frequencies. To borrow an expression from the radio engineer's vocabulary, the fans were heterodyning.

Actual measurement of the noise by the Electrical Research Products' engineers verified this theory. By means of sound level meters and frequency analyzers, these engineers made a series of measurements in the immediate region of the induced draft fans and the results of these measurements left no doubt as to what was happening. The results of these measurements are shown in the accompanying charts, which are the actual charts produced by the sound recording and analyzing instruments.

In Fig. 2, at the left, is shown the total overall noise level of a single I.D. fan and at the right the frequency composition of this noise when measured at a distance of 10 ft from the fans. The overall noise level record shows the small random variations normally encountered. The frequency analysis at the right shows a prominent 92 cycle per second component which is the characteristic blade frequency noise, that is the fan rpm multiplied by the number of blades of the rotor.

It should be mentioned here that both fans had 8-blade rotors. The records in Fig. 2 were taken with the fan running at 690 rpm. Since the fan has 8 blades, the resulting frequency is $690 \times 8 \div 60 = 92$ cycles per second. As will be noted this frequency is the predominant component in the frequency analysis chart. Note that this component is

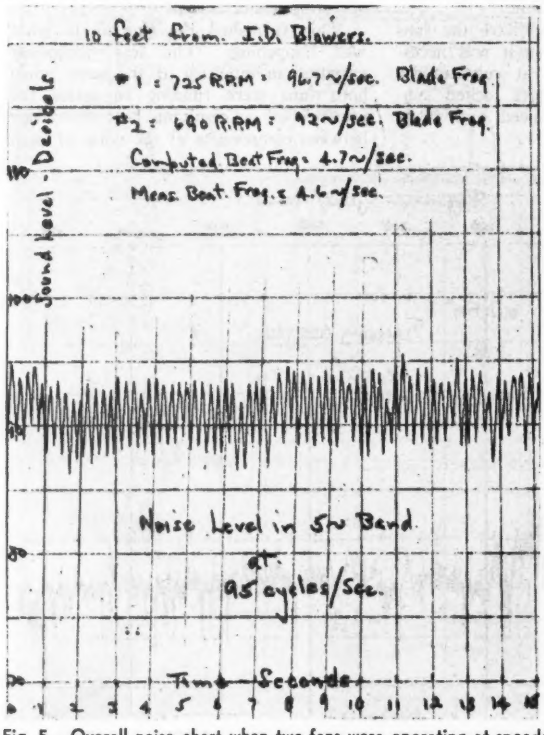

10 Feet From I.D. Blowers.
#1 = 725 R.P.M. = 96.7 ~/sec. Blade Freq.
#2 = 690 R.P.M. = 92 ~/sec. Blade Freq.
Computed Beat Freq. = 4.7 ~/sec.
Meas. Beat Freq. = 4.6 ~/sec.
Sound Level - Decibels
Noise Level in 5 ~ Band
at
95 cycles/Sec.
Time - Seconds

Fig. 5. Overall noise chart when two fans were operating at speeds of 725 and 690 rpm, respectively

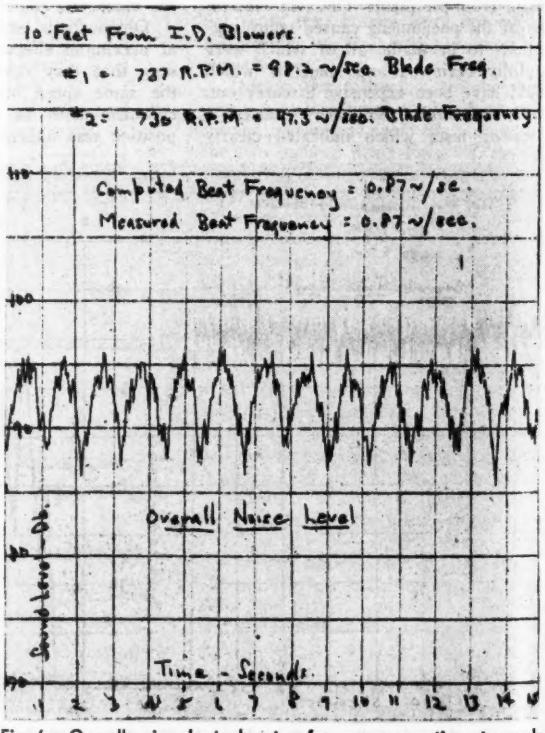

10 Feet From I.D. Blowers.
#1 = 737 R.P.M. = 98.2 ~/sec. Blade Freq.
#2 = 730 R.P.M. = 97.3 ~/sec. Blade Frequency
Computed Beat Frequency = 0.87 ~/sec.
Measured Beat Frequency = 0.87 ~/sec.
Overall Noise Level
Sound Level - Db
Time - Seconds

Fig. 6. Overall noise chart when two fans were operating at speeds of 737 and 730 rpm, respectively

the controlling factor in the magnitude of the overall noise level.

Figures 3 and 4 show similar records with both induced draft fans operating at the speed combinations of 570 and 680 rmp, and 690 and 695 rpm respectively. The frequency analyses of these speed combinations clearly show the blade frequency components of each unit. In addition, it will be observed that for the first combination, i.e. 570 and 680 rpm, the total overall noise level increased considerably over that of a single fan. It averages around 95 db against 90 db for just the single fan. In this case one fan operated at 570 rpm and the other at 680. The respective frequencies therefore were $570 \times 8 \div 60 = 76$ and $680 \times 8 \div 60 = 90.7$ cycles per second. No complaints had been made against this type of noise.

Now, look at Fig. 4. This is the record for the speed combination of 690 and 695 rpm. Here a striking difference will be noted at once. Not only has the overall noise level increased considerably but it varies periodically over the wide range of 16 db at a rate of 0.55 cycles per second.

This rate of variation corresponds to the arithmetic difference between the blade frequencies of the two fans and is known as the resultant beat frequency. With this combination, a severe noise disturbance of the type against which complaints had originated is produced.

A number of records were taken for various combinations of fan speeds and at different places with respect to the location of the fans but all bore out this beat frequency action. With further decreases in the differential speed between the two fans, corresponding increases in the noise was observed.

As the consulting engineers had already discovered, the sound measurements showed that when operating at exactly the same speeds and with a certain favorable phase relationship between them, minimum disturbing conditions could be produced. This condition could only be obtained momentarily.

Figures 5 and 6 show two other records made with speed combinations of 725 and 690 rpm, and 737 and 730 rpm, respectively. In the first case the beat frequency was computed to be 4.7 cycles per second and that actually measured was 4.6 cycles per second. In the second case both the computed and measured beat frequency was 0.87 cps.

A similar group of measurements were made in the open air on the roof over the plant with substantially similar results. It was never proved just how the noise was radiated, whether it came from the ducts, cinder catchers and other superstructures or whether it was fed by the fans directly into the gas stream and into the air.

All measurements pointed to the fact that noise disturbance was attributable directly to the beat frequencies produced by the two fans. To be certain that other factors did not enter the case, an investigation was also made to determine whether any peculiarities of the layout contributed to the disturbance, particularly from the point of view of resonance of the duct structure, and also the possible action of the stack as an organ pipe. All observations and data, as well as the past experiences of the Electrical Research Products' engineers on similar types of noise problems indicated that these were not contributing factors. *The noise disturbance was attributable solely to the acoustic interaction of the two fan units on each other when operating with small speed differentials between them.*

The Remedy

The remedy was simple. All that was needed was a scheme whereby the beat frequency would be moved into a range where it would not be heard or felt. As the charts indicated, this could be done by operating the fans at different speeds but since the fans had to operate at substantially equal speeds to provide proper division of load, another method was adopted. This involved changing the number of blades on *one* of the fan rotors.

It was shown that a resultant beat frequency of 12 cycles per second or greater would be required to avoid the disturbance. To fulfill this requirement the report submitted by Electrical Research Products, Inc., specifically recommended that one of the 8-blade fan rotors be changed to a 10-blade rotor, the other remaining as it was. With this arrangement, the report stated, assuming equal speed operation of the two fans in parallel, the blade frequencies components of the units would then produce beat frequencies of sufficiently high order to overcome the disturbance.

This was done. A new wheel with 10 blades was ordered and installed early in June 1939 and since that time there has never been a recurrence of the noise disturbance. While this change involved the expense of a new rotor, the one that was removed is still as good as new and is kept on hand in case the present 8-blade rotor wears out.

Thus the mystery was solved, simply, effectively and at little cost. W. M. Schuler, Plant Superintendent of the Jacob Ruppert Brewery, reports that the installation has operated satisfactorily ever since.

In closing the writer acknowledges his indebtedness to Mr. Schuler for his courtesy in supplying the material which served as the basis for this article.

"Why, Gus, you old rascal you—I have a few moments so thought I'd drop over and visit a spell."

Phos-Copper Brazing of Armature Coils

New method of making connections developed by Westinghouse as a consequence of the scarcity of tin has a number of advantages over the use of solder. The method is applicable to other jobs as well as the connection of terminals of armature coils

By C. LYNN
Manager, D-C Gen. Eng. Dept., Westinghouse Elec. & Mfg. Co.

SOLDER has been universally used for making the connections between armature coils and commutator necks and between armature cross connections and armature coils on direct current motors and generators since the development of d-c machines. Solder has been used because soldered joints are easily made and provide good contact when correctly made. Until very recently, no other commercially satisfactory means had been developed for making these joints. Soldered joints have three fundamental imperfections: (a) The joint is relatively weak mechanically, the strength decreasing very rapidly with increasing temperature due to the nature of the material, (b) the joints will not stand very high temperature since ordinary solder (50-50 solder) melts at approx 183 C and, (c) there is no known way of telling whether a good soldered joint has been made.

On some machines and on practically all machines with Class "B" insulation, which includes all railway equipment, these joints have been made with pure tin instead of solder on account of the higher temperatures at which these machines operate. Since tin melts at 232 C, higher operating temperatures can be employed when it is used.

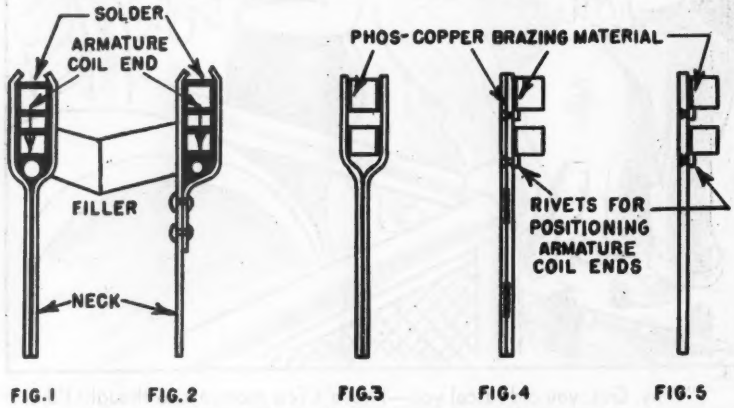
After our country's entry into the war, a drive was made to conserve tin on account of its scarcity and Westinghouse started developing a brazed type of joint for these connections. Similar efforts made in years past were never successful in developing a method that was commercially practical for large scale production. Brazing with a flame is impractical on account of the spread of heat and accompanying damage to adjacent parts, particularly to the insulation. This has, however, now been accomplished for commutators with open type necks.

Figures 1, 2, 3, 4, and 5 show the various types of commutator necks employed on Westinghouse machines. Figures 1 and 2 show standard types of construction used on soldered joints; Fig. 1 is most commonly used. Note, that in the case of Fig. 1 the neck is made of a double thickness of copper with the outer periphery opened to form a space for the insertion of the armature coil ends. This neck may be of 2 pieces, riveted or spot welded together, or may be of one piece folded to give two thicknesses. The second type shown in Fig. 2 is also used when the commutator bar pitch is very thin, in which case only a single thickness of neck material is used, with an additional piece riveted on, to form an opening, at the outer periphery for the armature coil ends. The soldering of these types of necks is similar and it is necessary to use filler pieces of copper of the same thickness as the armature coil ends, between the top and bottom armature conductors and in the opening below the bottom armature coil end.

Figure 3 shows a type of brazed joint in which the armature coil ends are simply brazed to the standard type of neck, as used with the soldered joint. However, the copper filler pieces have been omitted below the bottom conductor coil and between the top and bottom coil end. In brazing this type of joint, thin strips of phos-copper[1] approx 0.015 in. thick with a width equal to approx half the width of the neck in a direction parallel to the shaft, are inserted between each side of the armature coil ends and the neck. Heat, from a brazing transformer, is then applied with pressure to the joint by means of carbon tipped brazing tongs. After the phos-copper has melted (815 C) and has flowed over the surface to be brazed, the current is stopped but the pressure is maintained till the joint cools. In normal production, a blast of compressed air is applied directly to the joint whenever current is not flowing. Thus, when the circuit is interrupted at the end of the melting period, this air tends to rapidly cool the brazed joint. An improvement that has been developed consists of blowing a small stream of air in a radially-inward direction against and between the armature conductors just back of the commutator necks. This keeps the conductor cool; eliminates damage to insulation. In making a joint in this manner, it is possible to braze armature coils with Class "A" insulation without damage to the insulation. Since the armature conductors are brazed solidly to the commutator necks, no spacers are necessary between conductors or below the bottom, since it is not necessary to fill this space with brazing material. It should be pointed out that the resistance of a brazed joint is somewhat higher than that of a "good" soldered joint due to the inherent higher resistance of the material itself. However, since the resistance of either joint is a few micro-ohms only, the value is of no consequence.

Figure 4 shows another type of brazed joint. Here two pieces of copper are brazed together to form the neck. This method is used where the neck material has already been made, or where the necks have been partially formed in the shape shown in Fig. 1, and have then been re-formed to that of Fig. 4.

In Fig. 5, the neck itself is made of one piece of copper, with thickness equal to the total thickness of the soldered type neck shown in Figs. 1 or 2. This thickness, of course, varies with the design and current rating of the machine. In this construction small copper rivets are inserted in the neck (in the correct position before the necks are attached to the commutator bars) to properly locate in a radial position, the ends of the armature coils for brazing. It is also possible to omit these small rivets and simply locate the position of the armature coil ends,



Figs. 1-5. D-C generator and motor commutator neck constructions

[1] Phos-copper is an alloy of phosphorus and copper and is used as a brazing material for copper and copper base alloys. It has a low melting point and is free-flowing.

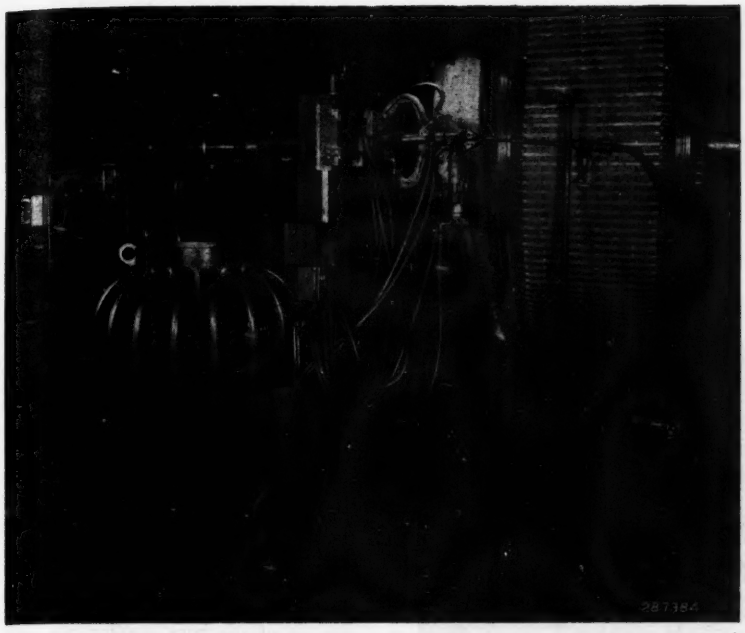


Fig. 6. Brazing armature coils to commutator necks using phos-copper and tong method

radially, by reference to the outer periphery of the armature iron, through use of a straight edge. Small pieces of phos-copper (approx 0.015 in. thick and about half the area of the overlapping of an armature coil end on the neck) are spot welded to the neck to prelocate the brazing material. This provides the exact amount of brazing material necessary for brazing the joint. Too little or too much phos-copper brazing material results in an inferior joint. After the necks are prepared in this manner, they are brazed into a slot machined in the bar. Before brazing was used for attaching the necks in the bars the necks were held in position in the slot in the bars by soldering and riveting with countersunk rivets. For the past two and a half years Westinghouse has eliminated this riveting and soldering and has simply brazed the necks into the slots.

Tong brazing with phos-copper is well suited to making multiple-joints as encountered on commutator necks and armature coil-ends, because it does not require a bright surface for the work. Flux, which may cause damage to adjacent insulation, cause corrosion of the metal and peeling of varnish and paint is not needed. Even copper which has been tinned or soldered can be brazed, if phos-copper brazing material is used. At room temperatures, the phos-copper joint is approximately four times as strong as a perfectly-formed soldered joint, using pure tin. With an increase in temperature, the phos-copper joint becomes many times stronger than a tinned or soldered joint. Then, too, the brazed joint can be taken apart when desired—by applying heat through use of the tong, and simply separating the pieces while hot.

In making armature coils for soldered joints, ends of the coils are pretinned after the coils are formed and before they are treated in varnish. After the coils have been treated in varnish, the varnish is removed from the ends by dipping into a pot of melted tin or solder. When soldering with pure tin, the pretinning must be done with the pure tin also, so as not to contaminate the final pure tin joint with lead. It is absolutely necessary to pretin the ends of the armature coils before making a soldered joint. It is also necessary to pretin the open ends of the commutator necks before soldering the armature coils to the necks.

When brazing is used, no tinning of any kind is necessary on the open end of the commutator necks. The armature coils, however, are pretinned and retinned in exactly the same manner when the coils are to be brazed as when they are to be soldered, except that pure tin need not be used. Attempts to eliminate pretinning and retinning of the coil ends (by various other methods for removing varnish from the coil ends such as sand blasting, acid treatment, etc.) have uncovered no method that compares, in ease and cheapness, to that of removing the varnish by tinning. Phos-copper brazing material is ideal since it will braze even with the coils tinned or covered with a thin amount of solder. Not only does it permit following through on the manufacturing program but also permits brazing armature coil-ends and commutator-neck joints, which have previously been soldered. In such cases, it is only necessary to split the joints, heat the material, remove (with a rag or other means) the bulk of the solder from the copper, place pieces of thin phos-copper strips in the joint (in the manner mentioned under the brazing of the type shown in Fig. 1) and braze the joint.

Westinghouse is continuing experiments and development work on brazing technique in order to improve brazed joints and cut down the time required to make them. At present, it takes somewhat longer to make brazed joints than soldered joints. Eventually, it is hoped that it will be possible to make brazed joints as quickly as soldered joints. Westinghouse tried applying phos-copper in other forms than by spot facing thin strips to the necks. One such method used phos-copper as a plating put on in the form of a metal spray. In this case, the surface of the

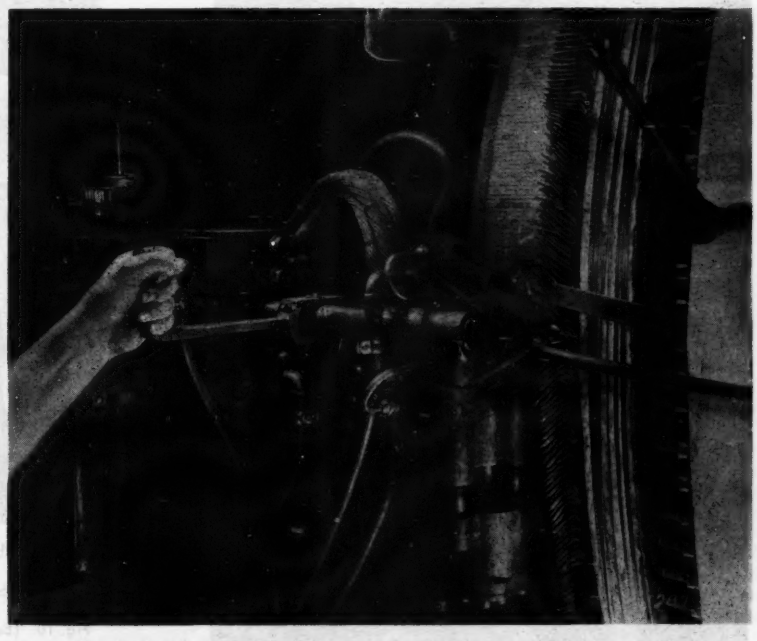


Fig. 7. Tong brazing with phos-copper showing close-up of head in operation

neck had to be sand blasted (or roughened in an equivalent manner) in order to get the phos-copper to stick to the neck.

In Westinghouse shops, brazing stands are used for work on the commutator necks. These stands consist of roller bearing supports, adjustable in height and spacing, to supporting the rotor by means of the shaft. This permits the armature to be placed in correct relationship to the brazing head and permits easy turning of the rotor, bringing different joints successively to the head. The brazing head itself consists of air operated "tongs" having parallel moving jaws. They can move inward or outward, in a radial direction along the commutator neck, for brazing the outer or inner armature coil ends. They can also move in an axial direction to permit insertion of the carbon jaw tips used for gripping the joints to be brazed. The carbon tips are thin and tapered and each is connected to the brazing transformer through suitable flexible leads. These tips can be shaped to any size required, depending upon space available between necks and size of necks and coil ends. It is necessary to bend adjacent necks slightly away from the neck being brazed. Some difficulty in bending may be encountered on extremely short necks. The neck being brazed lies in a horizontal position. By means of a lever, the carbons are positioned above and below the joint. A lever is pressed with the foot which admits air to a hydraulic cylinder and presses the carbons together. Current is applied by further travel of the foot lever. A continuous small stream of compressed air, blowing from a fixed orifice adjusted to the correct location for the particular armature, blows against the armature coil just back of the neck, keeping it cool and eliminating damage to insulation. When the prelocated phos-copper, previously spot welded to the neck, melts and flows out over the joint to be brazed, the operator releases the switch, stopping the current flow. However, he still maintains pressure on the joint. When the circuit is interrupted, an additional air blast blows through a hose and small orifice near the tip of the jaws, cooling the joint quite rapidly. In a few seconds the phos-copper will have hardened and the jaws can be released. See Figs. 6 and 7.

To break one of these joints the process is reversed. The joint is heated with the tong and as soon as the brazing material starts to flow, the current and pressure are released and the two pieces are knocked apart. It is possible to make and remake a joint 3 or 4 times without adding brazing material.

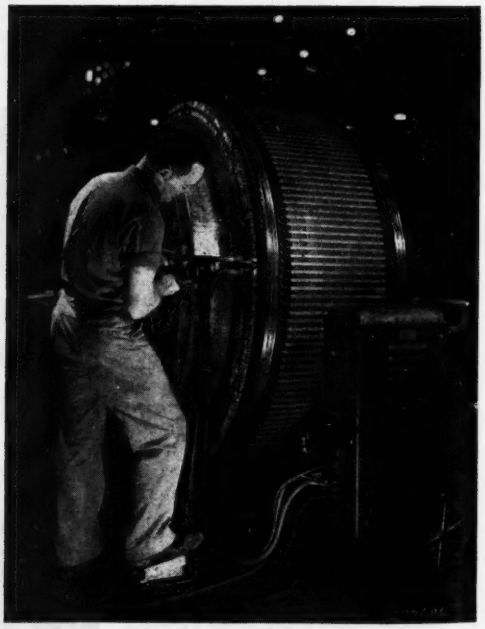


Fig. 8. (Above) Portable tong brazing outfit being used to join armature coils to necks

Fig. 9. (Above, left) Close-up of portable brazing tongs in action

Fig. 10. (Below, Left) Completed armature, after coil-neck joints have been brazed with phos-copper

Brazed joints made as replacements for soldered joints, using the type of construction shown in Fig. 3, are somewhat more difficult to open. Those made as shown in Figs. 4 and 5 are very easily opened. Fig. 10 shows the commutator end of a rather large armature whose armature coils and commutator necks have been phos-copper brazed, using the latest type of neck as shown in Fig. 5.

For use in the field or in manufacturing and repair shops such elaborate equipment is, of course, not needed nor justified. A portable type of brazing transformer equipment, with adjustments for varying the value of the brazing current, is satisfactory. Such portable equipment is available and includes a set of brazing tongs with carbon tips attached to the jaws. Figure 8 shows such an equipment in use, while Fig. 9 shows a closeup of brazing with the tongs.

Approximately 125 to 250 joints can be brazed with one set of carbon tips. Since the tips are small and inexpensive, the cost of carbon tip replacement is low. The portable brazing set not only includes a set of brazing tongs but also has connections for air supply, with suitable valves. These magnetic valves operate automatically in the proper sequence and supply the air to the joints being brazed whenever the current supply is opened. All that is necessary is to connect an air supply to the connection provided on the transformer case. This equipment is mounted on wheels to make it really portable.

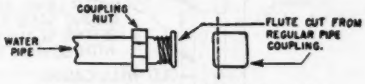
On the armatures of d-c machines, there are cross connections between points of equal potential, usually two pole pitches apart. Cross connection joints are ordinarily spaced approximately 2½-in. apart around the armature periphery and are normally located at the rear of the machine. The standard method of joining cross connections to armature coil clips has been by riveting and soldering. When using brazed joints for these connections, the riveting can be omitted. The cross connector can be brazed to the armature clip in the same manner used for commutator necks. In factory production, the brazing material (in the form of thin strips) is attached to the armature coil clips by means of spot welding, before winding.

Phos-copper brazing can be applied not only to commutator neck and cross connections but to many other jobs as well. It can be used on stators of a-c machines, on induction regulators, transformers, etc. It is not necessary to prelocate the brazing strip material since it can be fed to the work in the form of small rods about ⅛-in. in diameter. In d-c machines, Westinghouse has used phos-copper brazed joints for attaching cross connection clips to armature coils themselves for the past fifteen years. Never has there been a single failure of this brazed joint.

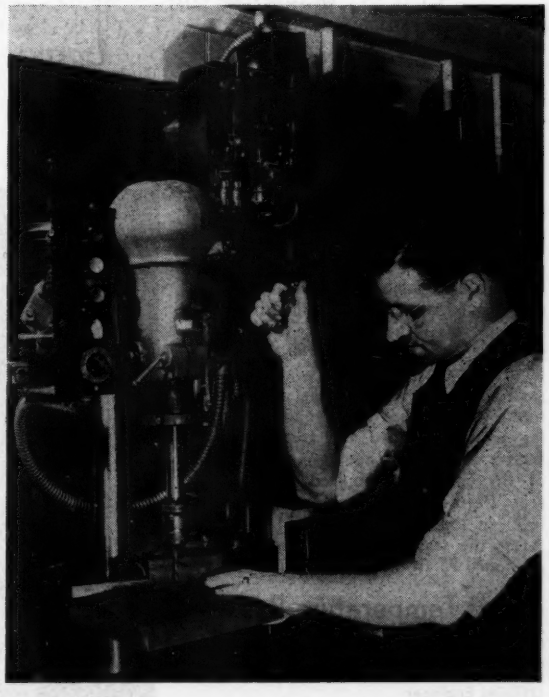
PRACTICAL HINTS AND KINKS

Electronic Motor Drive for Drill Press

THE APPLICATION of a ⅓-horsepower Thy-mo-trol drive to a small drill press at General Electric's Schenectady plant has greatly increased the drill's field of usefulness. A range of operating speeds from 25 rpm to 1750 rpm—obtained simply by turning a small knob on a push-button station—enables this simple drill press to do jobs that would otherwise require a much more complicated machine or machines.



Method of making fluted pipe joint



Photograph of drill press equipped with electronic motor drive. Control box at left. Grid-controlled rectifier tubes with enclosure removed, top center. Speeds between 25 rpm and 1750 rpm can be obtained with this control simply by turning the small radio type control knob on the control box

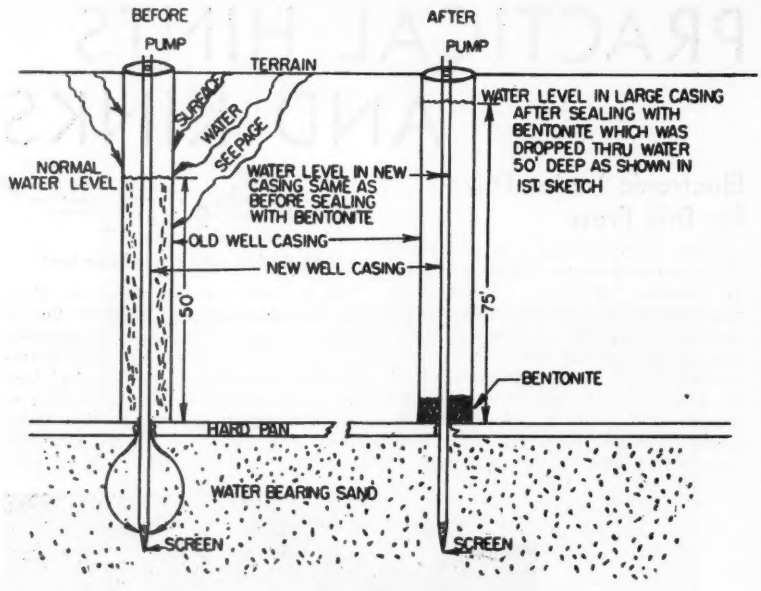
Speeds available on this Thy-mo-trol equipped drill are so much slower than those obtainable without changing pulleys on similar drills, that it can be used on hard-to-drill materials, such as molded compounds, and for the fly cutting of large diameter disks. Since the drive permits reversing as well as independent adjustment of speed in each direction, tapping can be done at the proper preselected speeds for both tap and back-out.

Fluting Pipe in an Emergency

By J. R. Kennedy

WHEN A FLUTED water pipe connected to a jet at a power plant rusted until it came in two, it was necessary to make an emergency repair or wait until a specially-fluted pipe ordered from a distant factory could arrive. In an effort to avoid a shut-down of the plant, an assistant mechanic tried to flute a piece of pipe by heating and spreading it while quite hot, but the pipe always cracked somewhere before it had been spread enough to enable the packing or union nut to make a water-tight joint. Since the jet could not be connected satisfactorily to a plain, unfluted pipe, it was necessary to resort to another method of obtaining a flute.

The problem was solved successfully in the following manner: A pipe coupling the same size as the water pipe was first obtained. From this a short piece was cut with a hacksaw. After placing the coupling nut on the water pipe, as shown in the accompanying sketch, the short piece of coupling was screwed onto the end of the pipe. Then to remove rough places left by the hacksaw in making the cut, the "flange" was filed until it was perfectly smooth in appearance, thus making a suitable place for a strip of packing to rest. (If a square flute is required, the square end of the piece of coupling can be turned toward the coupling nut. This will depend on whether the inside of the coupling nut is square or rounded out.) It was impossible to use parts from a standard coupling.



Overcoming Water Seepage

By G. F. SUCHY

THE ACCOMPANYING sketch shows how I overcame trouble due to water seepage into a well which at first appeared almost hopeless but which, when finally worked out, proved simple and inexpensive. The problem was to keep surface water from seeping into an old leaky well casing and in turn from entering the water bearing sand below the hardpan. As shown, Bentonite was dropped into the old well casing which hardened and formed an effective seal. Only about one cubic foot of Bentonite was required to make the seal. Before the seal was made the water level in the well was normal at 50 ft. After the seal had been made, the well contained 75 ft. of water as shown.

Direct Temperature Readings in Coal Piles

By C. C. Butterworth
Utilities Engineer
Curtiss-Wright Corp., Airplane Division
St. Louis Plants

MANY PLANT ENGINEERS, faced with the problem of coal storage, immediately envision coal pile fires with all their accompanying trouble and expense. Much thought has been given to the proper ways of storing coal to avoid, so far as is possible, the danger of fire.

We must admit, however, that it is virtually impossible to eliminate all possibility of spontaneous combustion. The next-best thing is to provide some means of warning the operating personnel of the imminence of fire. Some engineers have even gone so far as to bury thermocouples in their coal piles. And one company has brought out a device which uses a fusible link to indicate "hot spots".

Some months ago the writer was faced with the necessity of providing for storage of approximately 6,000 tons of relatively low-grade coal in the open. The space available was quite small for this amount of coal, and it was therefore necessary to pile the coal to a considerable height. Since the danger of fire in piled coal increases rapidly as the depth of the pile increases, several sleepless nights ensued as the pile grew.

We therefore had the Maintenance Department fabricate several inch-and-a-quarter pipes with a conical point at one end, having varying lengths. These pipes were driven down into the coal pile on twenty-foot centers and partially filled with water. Several times each week, the Operating Engineer drops a stem type thermometer down the pipe and into the water, thus obtaining a more or less accurate temperature reading of the coal surrounding the pipe. Since any heating along the length of the pipe will be transmitted to the water, convection currents will soon bring all the water above the hot spot to the same temperature.

The writer is not aware of similar schemes having been previously used, and the information is passed along in the hope that others may want to use it, thus avoiding one or two additional grey hairs.

CATPOWER

Although the Grand Coulee Dam (Washington) power plant has available more than a million horsepower of energy—second largest block of power in the world—Bureau of Reclamation workmen recently found it necessary to resort to the use of "catpower" in construction work on the project. To string 500 ft of cable through a 24-in. winding drain pipe, the men tied a string to a cat and energized its movement through the pipe with the aid of a blast of compressed air. The string was then tied to a rope and a rope to the cable to complete the operation. The Grand Coulee power plant, rated at more than 800,000 kw, in January produced a world's record output of energy—more than 600,000,000 kwhr. (Photo U. S. Bureau of Reclamation)

LETTERS AND COMMENTS

A Plea from the Small Plant Operator

THE EDITORIAL ARTICLE, "How Do You Read or Do You?" in the January issue of POWER PLANT ENGINEERING, prompted me to write this letter.

The information contained in POWER PLANT ENGINEERING is always excellent and I look forward each month to reading it. But, why is it, that about 99 per cent of the articles presented concern large power stations and industrial plants? It seems to me that most of the articles are about these high capacity plants where they kick a half million killowatts around like so many marbles.

Now, these articles are fine and probably are needed now that we are at war but what percentage of all engineers and firemen are employed in these high capacity plants? I have no statistics at hand to answer that question but, judging from my own experience, I would say that a very small number of men are employed in the large plants compared to those that work in small, older plants.

Of course, I am quite aware of the many varied and complex problems facing these high capacity plant operators; any one of such large plants, probably gives rise to as many problems as a score of small plants put together. Nevertheless, the small plant operators are faced with problems that to them, are as complex and varied as any confronting the large plant operator.

Let me outline a typical small plant; it is one in which I worked before entering the army, so I speak from actual experience. This plant had three 72-in, HRT boilers, 17 ft, 6 in. in length. They had 124 three-inch tubes each and were set in an overhanging setting. We had two duplex double-acting feed pumps, one a 6 by 4 by 6 in., and one somewhat larger; I have forgotten the actual dimensions. In the engine room we had three engines; No. 1 was a slide valve Erie Ball engine, direct-connected to a 220-v, d-c generator. Number 2 engine was identical except that it had non-releasing rotary valves. Number 3 was much larger, being a four cylinder vertical Ames Uniflow. It had 10 by 10-in. cylinders and turned over at 350 rpm. It also was direct-connected to a 220 v, d-c generator. The average load ran about 200 to 300 amp, while the boilers usually evaporated from 7000 to 14,000 lb per hr.

We also had two ammonia compressors, three Freon compressors, two brine circulating pumps and two heating system return pumps. As can probably be surmised, this plant was in a large western Massachusetts hotel. I worked in this plant for slightly over a year as fireman. It is to this type of plant that I wish the articles in POWER PLANT ENGINEERING would give more attention.

Another thing I wish to call attention to is the rather highly technical nature of many of the articles. Once again let me say that such articles are probably fine for the personnel of large power stations and for 20-yr veterans of the profession, but what about fellows like myself who are just getting into the game? Take myself for example.

I am 23 yr old, hold a Massachusetts Third Class engineers license. I have been in the game actively for the last 4 yr. My father holds a Second Class ticket and most of what I know, I learned from him. He is the best friend I have ever had or will ever have, and he is as good a small plant engineer as you will find in the State of Massachusetts. However, I am sure that he has never operated a boiler of over 25,000 lb per hr capacity or an engine of over 750 hp. These capacities, I consider to involve about the largest of the small plants. The largest plant I have ever operated in was the plant I have described in this letter. Now, in the army, I am operating a plant where my largest boiler is a pocket size affair of only 50 hp, with no engine or turbine.

From this, you probably can see that articles which deal with boilers of 500,000 lb per hr and turbogenerators of 100,000 kva, are pretty much beyond our needs. There are many fellows like myself who are interested in such large plants but first of all we must start from the bottom and work up. When a pilot is being trained, the first thing he is taught is what the various controls are for and how they function. The instructor does not say "Hop in, Joe, I'll show you how to do an outside loop in this B-19." Of course, not; he feels that he is too young to die. It is the same way with engineers. They have to start with fundamentals and then gradually increase their knowledge. You don't take a green man and turn him loose in a plant with a 500,000 lb per hr boiler and say, "There it is, take charge of it." Not if you value the boiler, or the man.

So, you see, Mr. Editor, what I am making a plea for, is more small plant articles and more articles comprehensible to a fellow just starting in, like myself. I should like to have the opinions of other readers on this, not only for my own interest but also because I feel such opinions will be of value to other readers of the magazine. After all, I assume that POWER PLANT ENGINEERING is a magazine for small plant operators as well as the high capacity plant operator.

Ft. Devens, Mass. PVT. WM. GREEN

The Life of a Maintenance Man in a Hospital

THE LIFE of a maintenance man seems, at times, to be just one bust after another—in other words, his life is one big bust. Occasionally, however, something comes up that convinces him that there are compensations for his misery. To me, personally, these bright spots occur when some piece of equipment is returned with the cheering information that "it can't be repaired"—or, "nothing more can be done to it". I accept such an adverse report as a definite challenge, and frequently, I am able to put back into circulation, apparatus that was given up as of no further use to anyone but the junk dealer.

An important and essential part of hospital equipment is the oxygen tent and the tanks and valves that go with it. Prior to the increasing use of sulfa drugs in the treatment of pneumonia, almost every serious case was given oxygen in the tent, sometimes for days. Although not used so frequently in the last few years, our apparatus must always be in repair and immediately available. It is one of my jobs to see that this is done.

Sometime ago, the double-feed reducing valve, which cuts down the tank pressure of, initially, 2250 psi, to a pressure which will deliver 6 litres per minute, began to act erratically. I sent it in for repairs and it came back, supposedly repaired, three times. I decided that I certainly could do no worse and went to work with results that were gratifying and certainly interesting. My methods were, so far as I knew, entirely original, for I had never seen, in any book or magazine, a description of what I planned to do. (Note—Any feed is possible from 1 to 15 litres per min.)

A dimly remembered experiment in chemistry, in high school days, had to do with an apparatus known as a pneumatic trough. I recalled it as a means of collecting gases not soluble in water, and so I made one. I took a No. 10 empty tin can out of the trash barrel, a gallon glass jug, also salvage, and a small tub.

I cut a slit in the side of the can to make it easier to insert a rubber tube in the mouth of the jug. Filling the jug with water, as well as partially filling the tub, I inverted the jug, under water and set it in the top of the can—the can resting on the bottom of the tub. I was then all set to test my reducing valve.

A discha-ge, from the valve, of 6 litres per minute, means approximately, 1.58 gal. It will be evident that the contents of the jug would be displaced in 38 sec. The difference between this reading and the actual reading on the gage would be the amount of error.

As a result of my experiments, I found that the double-feed valve was so far out that no reading at all showed on the gage at the standard feed. I corrected this condition, temporarily, by making a stop for the adjusting hand wheel of the valve and setting it at a point which delivered the correct amount of oxygen.

The firm who had attempted repairs had at last assumed that something was screwy with the gage which indicated the rate of feed. Having now a means of check and comparison, I checked the two new ones I had been sent against the one on the valve and found them all to have the same reading. It now seemed up to me to discover a way to make the gage read 6 litres while the trough was collecting gas at that rate.

After much experimenting, I decided that the back pressure on the feed indicating gage was inadequate and corrected the condition with the use of a back pressure diaphragm in the feed line between valve and tent. It took some time to find just the right size of aperture for the diaphragm but I eventually succeeded in getting the hand of the gage to rest on exactly 6 litres when collecting that amount with my trough.

The big "H" tanks previously charged to the 6000 litre, or 220 cu ft point are now allowed, by government ruling, to be overcharged 10 per cent. After standing around in a rather warm room for an extended period, the reading on the pressure gage frequently rises to 2250 psi. So, thanks to the Interstate Commerce Commission, we now receive 244 cu ft instead of 220. The frangible disc, provided as a safety measure, ruptures at a point between 2600 and 2800 psi.

I have found it worth-while to know that the contents of the tank will supply the tent for a period roughly equal to the litres indicated on the pressure gage, divided by the rate of feed. For instance, if there are 3000 litres left in the tank and the rate of feed is 6 litres, the tank will last for 500 more min or, roughly 6 hr. We never allow a tank to become completely discharged before replacing with a fresh one. The delay would mean that, for a certain length of time, the patient would be without oxygen.

I have found my pneumatic trough to be useful, also, in checking the condition of our acid-soda fire extinguishers. It is a general and recommended practice to discharge and recharge this type of extinguisher, at least once a year. I test the reaction between acid and soda once a year, and, if that is satisfactory, consider the extinguisher to be in good working order for another year.

My test is as follows: I take 4 oz of liquid from the extinguisher and put it in a small glass jar for which I have a rubber stopper with two holes through it. Through one of the holes, I insert a glass tube, and, to the other end of this tube, I attach, tightly, a rubber tube. The rubber tube leads to the jar of water inverted in a can or pail of water. I take, from the acid bottle of the extinguisher, a standard amount of sulphuric acid, with a fountain pen filler or medicine dropper. I fill the dropper not over half full. I push this carefully down through the second hole in the rubber stopper and discharge the acid into the liquid in the jar. After the initial reaction, I shake the jar thoroughly until all gassing has stopped. I find that conditions in an extinguisher which has not been charged for 2 yr, to be about as follows: The water level has receded very little. The acid level in the bottle has risen from 2⅜ in. to 3⅜ in. This increase in acid level is due to the absorption of water vapor. Nevertheless, I find, with the use of the trough that there is an entirely adequate reaction, and a discharge of the extinguisher every 2 or 3 yr bears out the findings of the trough.

In a test of the weakened acid in comparison with fresh acid taken out of storage, I find that the CO_2 released by the weakened acid (after 2 yr period) is ⅔ the amount released by the fresh acid. Nevertheless there is plenty of pressure and range at the nozzle.

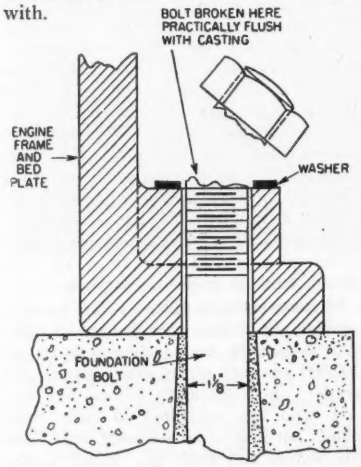
ARTHUR H. PARKER
Peterborough, N. H.

Repairing a Broken Anchor Bolt

Here is a little problem that seems to have only one or two good solutions. Yet a flood of different answers descended on us after it was published as Question No. 247 in the February issue. Here 10 variations of the theme are illustrated, plus good comment on bolting. It all proves that the power engineer must be, first of all, a good mechanic

FIRST OF ALL, our heartiest thanks to all those who contributed so generously of their time in making sketches and giving comments to C. I. P. on his broken anchor bolt problem, published in the February issue.

He stated, you remember, that one of the anchor bolts on one of his 75-hp Diesel engines had broken off almost flush with the bed plate. He wanted to know the best way to repair it without weakening the bed plate and without lifting the engine from the foundation to replace the bolt, for this would necessitate a long shut-down that he could not afford, besides a lot of work in re-aligning the engine. The situation is as shown in Sketch No. 1 herewith.



Sketch No. 1 by C. I. P. showing how anchor bolt of engine broke off flush with bed plate

Well, the first three suggestions, from C. F. Smith and Henry Grassi, did not come in until just as we were sending the March issue to press. They appear on page 110 of that issue. Immediately after that issue had gone to press, however, a flood of answers and sketches and comments descended on us.

These ideas divide themselves generally into a few groups, which are summarized below. They brought out a number of interesting points, among them the question of just how much room there is to work in between the bolt and the engine frame. Another point emphasized by several engineers was the desirability of having nuts on holding-down or anchor bolts faced off at right angles to the bolt so they will not exert a bending strain on the bolt when tightened down. A third point brought up was that of using proper methods of tightening the nut.

Group 1—Welding On An Extension

A number of engineers advocated simply welding an extension bolt, properly threaded, onto the top of the broken bolt, in the same general manner as shown by C. F. Smith in Sketch No. 1, page 110, March issue and Sketch No. 2 herewith. These engineers included: Geo. F. McNally, Kearny, N. J.; Wm. Heiwig, Seymour, Ind.; Chas. W. Parks, Baltimore, Md.; R. Williamson, Watertown, Mass.; W. J. Hertlene, Newark, N. J.; Dean B. Pettit, Ellicottville, N. Y.; N. W. Denson, Montour Falls, N. Y.; Martin N. Gozdenovich, Fairview, N. J.;

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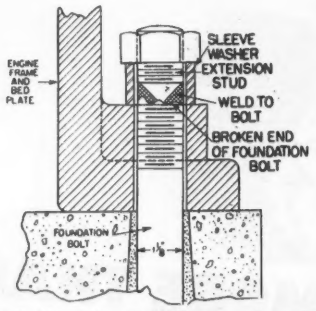


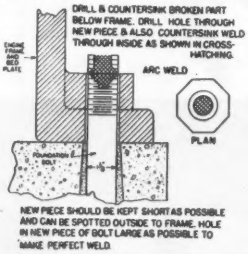
Sketch No. 2 by R. Williamson shows how extension bolt can be welded onto broken anchor bolt

Rembert Ray, Los Angeles, Calif.; Bro. John Jos. Geisen, St. Joseph's College, Westmont, Ill. The fundamental principle is as shown in Sketch No. 2 herewith. Most of them pointed out that allowance must be made for a much thicker washer or sleeve against which to tighten down the nut on the extension.

Martin Gozdenovich points out that "C. I. P. must remember that whoever tightens up the nut on the bolt should not use a four-foot length of pipe on the end of the wrench, because excessive strain tends to set up all sorts of creaks and groans in a bolt that may cause the same thing to happen again. All that is needed is a little elbow grease and a few sharp taps with a ball-peen hammer on the end of the wrench."

But there were a number of other interesting comments and variations of this welding procedure as follows:

W. J. Hertlene suggests a method for welding the extension from the inside, as shown in Sketch No. 3.


DRILL & COUNTERSINK BROKEN PART BELOW FRAME. DRILL HOLE THROUGH NEW PIECE & ALSO COUNTERSINK WELD THROUGH INSIDE AS SHOWN IN CROSS-HATCHING.
ARC WELD
PLAN
NEW PIECE SHOULD BE KEPT SHORT AS POSSIBLE AND CAN BE SPOTTED OUTSIDE TO FRAME. HOLE IN NEW PIECE OF BOLT LARGE AS POSSIBLE TO MAKE PERFECT WELD

Sketch No. 3 shows how W. J. Hertlene would weld extension from inside through drilled hole

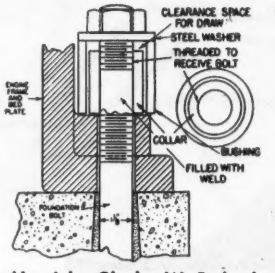
Dean Pettit says to use arc welding for this job. "Don't ever try gas welding on a job of this kind," he says. "If the engine has quite a few cylinders and plenty of foundation bolts," he adds, "the matter is not as serious as it would be on a two-cylinder outfit with only four bolts—but in any event a broken foundation bolt should be repaired promptly before damaged grouting and other sad events can occur."

Here is another variation:

Use a Welded and Threaded Collar, Says Parks

A VERY effective method of repairing the broken bolt shown in Sketch No. 4 is as follows: Turn out a steel collar whose internal diameter is that of the thread depth of the broken bolt and at least two diameters long and as thick as space will permit. Thread the upper half for the same thread as the bolt. Place the collar squarely over the broken bolt and weld in place, building up at least half of the length of the collar. Take a stud of the same thread as the bolt and screw firmly into the threaded collar. Turn out another collar that will slip snugly over the threaded one but about ¼ in. longer to allow for draw. Turn out a steel washer that will lay on top of the outside collar. Screw a nut on the stud and draw downtight on the washer. If the work is done neatly, the job will look fairly good and will be nearly as strong as the original bolt. Sketch No. 4 will show exactly how the job is done. This has proved a very good kink many a time and should work for you.

Baltimore, Md. CHAS. W. PARKS



Sketch No. 4 by Charles W. Parks showing use of welded collar

The idea shown in Sketch No. 5 was suggested by Wm. Heiwig and also by Grip-Sack Cy and Thos. W. Benson, Philadelphia, Pa. Mr. Heiwig says: "He should be sure, when he sets his form for his cement, to bring the new cement as far up on his engine base as he possibly can to take care of the shrinkage. I repaired an anchor bolt under a large Corliss in this manner. The bolt was broken off 18 in. below the engine base. But after this repair it never gave any trouble as long as the engine was in use, which was about 12 yr."

Mr. Benson also says that this method does not weaken the original anchoring of the bolt and will be as strong as the original if the welding is properly done.

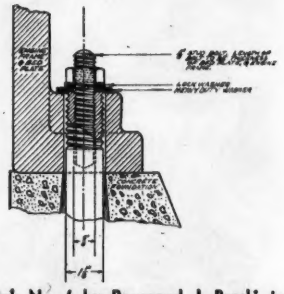
H. W. Denson advocates the same procedure as shown in Sketch No. 5 but in addition suggests welding two extra bars alongside the welded joint to reinforce it. H. A. Furer makes the same suggestion, except that for the reinforcing bars he would use two pieces of shafting a foot long.

CUT OUT FOUNDATION AROUND ANCHOR BOLT, CUT ANCHOR BOLT OFF HERE, TAKE OUT
BROKEN PIECE, WELD ON NEW STUB WITH THREAD ON ONE END. FILL HOLE WITH CONCRETE PUT NUT ON ANCHOR BOLT AND DRAW UP TIGHT.
BED PLATE

Sketch No. 5 by Grip-Sack Cy showing how foundation can be cut to weld bolt below frame. Can be done with engine in operation, he says

Group 2—Tapping in a Smaller Bolt

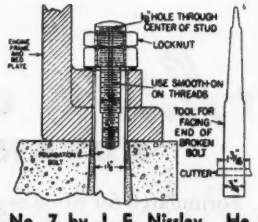
Several engineers suggested adding an extension to the broken bolt by drilling and tapping a smaller bolt into the top of the broken bolt, similar to G. F. Smith's Sketch No. 2, page 110 February issue.



Sketch No. 6 by Raymond J. Braski, typical of suggestions for inserting smaller bolt in top of broken bolt

Raymond J. Braski of Chicago, Ill., in suggesting this, says he had this same thing happen on a CO_2 compressor, couldn't afford to shut-down for the same reason given by C. I. P., repaired the bolt as shown in Sketch No. 6 with complete success.

J. E. Nissley of Richmond, Va., shows another method of doing this as shown in Fig. 7, including a special facing tool for the job.



Sketch No. 7 by J. E. Nissley. He would thread extension thus, face broken bolt end with tool built as shown at right

W. C. Borchelt of Aberdeen, Miss., suggesting that a ¾-in. extension bolt be tapped in as in Fig. 6, points out that this will handle less than half the total stress of the original bolt. He adds "If the foundation and floor design permit, I believe a new 1⅛-in. bolt could be installed by digging out the foundation or drilling through the floor and replacing the broken bolt." Mr. Borchelt also says that C. I. P. ought to read Front Lines, page 7, paragraph 2, sentences 1 and 2, February issue, commenting on correct nut tightening procedure.

J. R. Darnell, Naperville, Ill., suggests drilling and tapping the present 1⅛-in. bolt to receive a ¾-in. by 3-in. cap screw.

Finally, here is an entirely different method of adding an extension:

Mullen Would Shrink Fit the Extension

The way I would do this would be to drill a hole in the top of the anchor bolt, the hole to be ⅝ in. diam and 2 in. deep. I would insert the extension

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Fig. 16
"Renewo" Globe

Fig. 1640
"King-clip" Gate

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Fig. 1430
Iron Body Gate

Fig. 1938
Steel Gate

Fig. 2125
Bronze Gate

Fig. 123
"N-M-D" Globe
(Non-Metallic Disc)

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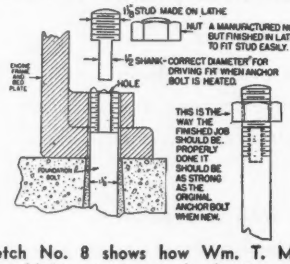
piece made to fit into this hole as shown in Sketch No. 8 so it will extend above the bed-plate far enough to receive the nut and a washer.

Then heat would be applied to the holding-down bolt so as to expand it as much as 0.004 in. and the shank of the extension would be driven in. It could be figured for a driving fit, when the bolt was cool, but when the anchor bolt is heated this shank end of stud would have to fit in very snugly so that when everything cooled it would be a tight fit. The portion of the stud above the shank will be threaded on the lathe and the nut fitted at this point so as to be ready to tighten the nut as soon as the stud is cool.

Philadelphia, Pa. WM. T. MULLEN

Editor's Note—How about shrinking the extension with dry ice? See Question No. 218, March, 1943 and answers to it in June and October, 1943 issues.


1⅝ STUD MADE ON LATHE
NUT
A MANUFACTURED NUT BUT FINISHED IN LATHE TO FIT STUD EASILY.
½ SHANK—CORRECT DIAMETER FOR DRIVING FIT WHEN ANCHOR BOLT IS HEATED.
HOLE
ENGINE FRAME AND BED PLATE
FOUNDATION BOLT
THIS IS THE WAY THE FINISHED JOB SHOULD BE. PROPERLY DONE IT SHOULD BE AS STRONG AS THE ORIGINAL ANCHOR BOLT WHEN NEW.

Sketch No. 8 shows how Wm. T. Mullen would fit extension in by heating and shrinking

Group 3—Using a Sleeve Nut

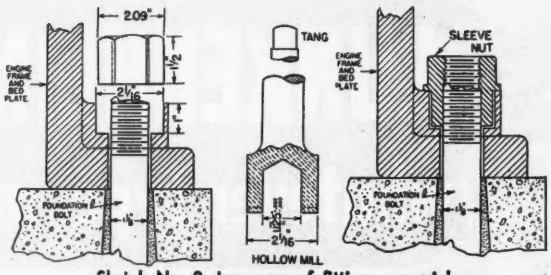
A number of suggestions were made for using a sleeve nut or cap nut on the existing anchor bolt, without trying to add an extension to the bolt. The sketches show this.

Ray D. Boyd of Sunray, Texas, in advocating this, points out that it is a good practice to face the nut back about ⅛ in. A nut faced exactly at right angles to the thread will pull straight on the bolt, otherwise it will strain it sideways, he says. He adds that it would be a good plan to face all the nuts on the foundation bolts of this unit.

Raymond Septor of South Amboy, N. J., suggests the use of a sleeve nut or special cap nut as shown in Fig. 9, in case it is not desirable to weld an extension on the bolt as in Fig. 2.

George McNally's idea for a special sleeve nut is shown in Fig. 9A. "Another method involving a little more machine or hand work," says McNally, "would be to cut down into the bolt hole enough clearance to permit a sleeve nut to be applied as shown in Sketch No. 9A. This clearance could be made by drilling a number of small holes around this bolt hole and using a fine chisel to cut out the casting around the bolt. A special nut would then have to be made, with an extension to catch the threads of the bolt below the point of the break for a length of thread equal to the diameter of the bolt, in this case 1⅛ in."

Joseph A. Kendrick, Baltimore, Md., says, "If there is sufficient room beside the engine base plate to rig up a drilling operation, it may be possible to bore



Sketch No. 9, two ways of fitting a special sleeve nut. A—McNally's idea of chipping out frame and using special nut. B—Kendrick's idea, showing hollow mill for cutting out frame metal around bolt and using extra deep special nut

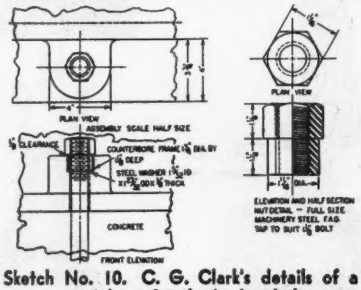
out a recess around the broken bolt as shown in Sketch No. 9B. To do this, you will need a tool known as a hollow mill, with which to make the cylindrical recess. At the beginning of the operation, a very light cut should be taken which can be increased as the tool cuts deeper and has the metal walls and the broken bolt to guide it. A special size nut, approximately 1½ in. deep, should be made so that there will be wrench room for finally tightening down."

Clark Gives Details for Special Nut

Sketch No. 10 illustrates one method of repair for C. I. P.'s engine bolt. The dimensions of bed plate have been assumed as shown and may or may not be correct. The bolt hole can be counterbored with a hole saw by first drilling a ¼-in. or ⅜-in. diam guide hole in the top of the bolt. If a hole saw is not available, a cutting tool can be improvised with a ratchet drill handle and a small boring bar. The hole will have to be carefully finished by hand chipping

If a lathe is not available for turning the special nut, a standard nut can be substituted by grinding the hexagon points to give a uniform 1¹¹⁄₁₆ in. OD. Wings can be welded to the top to allow a bar to be used for tightening.

Saint John, N. B., Canada C. G. CLARK



Sketch No. 10. C. G. Clark's details of a special nut for the broken bolt

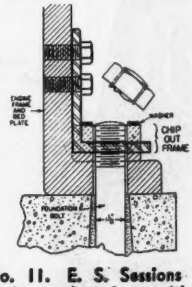
Loren R. Jones, Atchison, Kansas, says that he repaired an anchor bolt broken like this, on a 22-ton ice machine, by cutting away the concrete under the frame, cutting off the bolt and welding an extension on to it, as shown in Sketch No. 5.

"To solve his problem, as the bolt is 1⅛ in., C. I. P. could drill and tap it for a ¾-in. stud," comments R. L. Brown of Sloat, California. "But this would only be a make-shift and wouldn't have much strength. He might be able to pull the bolt out of the sulphur or whatever grouting was used around the bolt, after he has cut the bolt off below with the acetylene torch or taken the bottom anchor nut off, if the foundation is built with a pocket at the bottom of the bolt to hold a nut and washer.

"C. I. P. could also drill and tap bolt for a ¾-in. left-hand stud and try to screw bolt out of anchor nut this way. A lot depends on what kind of material was used around the 1⅛-in. foundation bolt when the engine was set. If sulphur or a hardening cement was used, this method would be useless. If there has been a steel casing part way, it will be a different story.

"He could also use the jack-hammer to chisel out a chunk of concrete around the bolt just below the engine bed framework without weakening the foundation too much. Then the bolt could be cut and another stud welded on, as in Sketch No. 5. Then, of course, the concrete would have to be re-run, which could be accomplished without shutting the unit down too long or perhaps when the load is light.

Finally, here is a method entirely different from any of the above:



Sketch No. 11. E. S. Sessions would cut down bed plate and reinforce with angle iron

Sessions Would Use a Bolted Angle

If there is room available to work in, the portion of the engine frame shown in heavy cross-hatching on Sketch No. 11 could be chipped away far enough for a full nut, plus the thickness of the angle iron. This angle iron should be bolted higher up, as conditions permit. The angle gives strength to replace that lost by removing the bed plate metal.

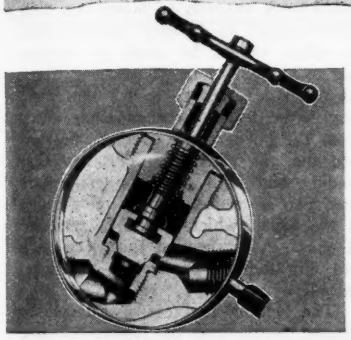
Bristol, Conn. E. S. SESSIONS

There, gentlemen, is the way to fix the broken anchor bolt.

How to buy a *Forged Steel Stop* VALVE...

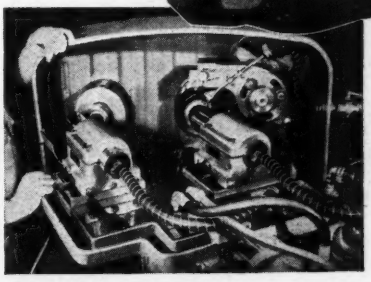
THERE'S more to buying a forged steel stop valve than a figure number, a price and a purchase order if you're interested in fitness for tough service and the real economy of long life and low maintenance. It's the important details of design, construction and processing of each material and part that makes the difference in forged steel stop valves.

Here's what to look for!



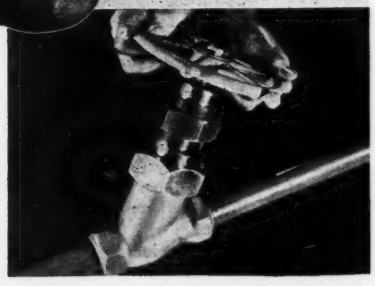
1 THE "WEAR ZONE"

Here's where a valve takes the most punishment. Edward builds extra life and extra protection against corrosion and erosion into this "wear zone" through EValloy stainless steel or Stellite seats and disks. Threads of both the seat and body are of the finest Class 4 commercial fit.



2 DROP TIGHT FIT

Seats and disks for Edward forged steel stop valves are precision borized in pairs on special machines (above). Mated seats and disks, absolutely concentric and smooth, show practically 100 per cent bearing surface when tested with blued gages. The result—drop tight valve closure.

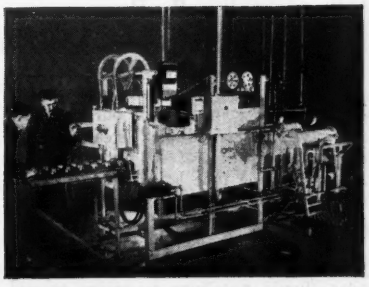


3 EASY OPERATION

Handwheels are mighty important. Handwheels for Edward forged steel stop valves are strong malleable iron, knobbed and easy to grip even with wet hands. Oversize dimensions facilitate operation. No other manufacturer puts larger handwheels on steel valves of like size.

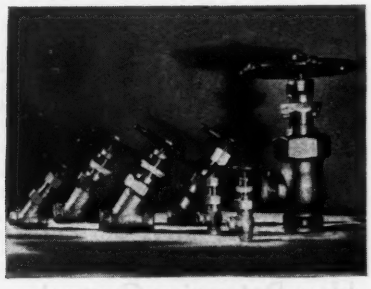
4 EVALIZED SURFACES

EValizing, the new exclusively Edward plating process, adds years of service to stem bearing surfaces, protects other exposed surfaces such as packing nuts, bonnets, junk rings, etc., against rust, corrosion and abrasion. Above, a section of the Edward plating department.



5 PROPER PROCESSING

Bodies, bonnets, seats, disks—all principal parts of Edward steel stop valves go right from the drop forge hammers to special furnaces, like the one above, for heat treatment under the control of Edward metallurgists for protection against indeterminate stress in service.



6 WIDE ADAPTABILITY

Globe or angle, inside screw or O. S. & Y., sizes ¼ in. to 2 in., screwed ends or ideally proportioned socket welding ends. But in every size and type, they're all steel, equal to any stress or strain. For illustrations, dimensions and concise data on the Edward line, write for Cat. No. 101.

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EDWARD *Steel* VALVES

Questions And Answers

Question No. 255

What Do You Do About Goggles, Boiler Suits, Respirators, Gas Alarms?

KINDLY tell me where I can buy a head-gear or suit with a built-in respirator to use for boiler cleaning and inspection.

Great Lakes, Ill. C. L.

WHERE can I buy glasses or goggles with blue lenses, side guards and bows to wear when firing?

Keene, N. H. F. W.

IS THERE any device I can install in the ash-handling space behind my boilers to give warning of the presence of dangerous amounts of CO and other gases poisonous to men who have to work there at various times? I have already had a man overcome by CO in that space (at least the medical men said it was CO poisoning). But provision for properly ventilating the space will have to wait until after the war, since we are not classed as an essential industry and haven't so far been able to get the necessary equipment.

Chicago, Ill. C. A. B.

Editor's Note: The above questions are typical of many we have received during the past few months. They all bear on the general question of the safety of the power plant operating personnel. We publish them together in the hope that readers will be led to comment on the entire subject of protection of operating men against routine and obvious hazards of the business. As to the specific questions, we have already supplied the inquirers with names of manufactured products designed to meet their requirements. But if you have any comments on general safety procedures that you think would help fellow engineers, let's have them.

Question No. 256

How Determine Correct Suction Pressure on CO_2 Machine?

IN THE OPERATION of a CO_2 compressor in a theater air-conditioning plant, is there any set rule or chart that will give me the exact suction pressure to carry? The old method of depending on the "feel" either side of the expansion valves seems to leave the operating engineer wondering if he is getting all the plant can give him in these days when power and fuel must be conserved for war.

Boston, Mass. A. T. K.

Question No. 257

What Causes Locking of Wound-rotor Motor Converted to Compensator Starting?

We have changed over a Form L motor to compensator starting by removing the internal resistance and substituting copper rings. We have been having trouble with the converted motor locking when trying to start it. We find, however, that by rotating the rotor a few degrees by hand, it will start. We have had similar trouble with wound-rotor motors that have also been changed to compensator starting by short-circuiting the slip rings. I would appreciate an explanation of the cause of this rotor locking and suggestions for a remedy.

Peabody, Mass. C. W. S.

Editor's Note: The Form L motor is an old type of wound-rotor motor equipped with an internal resistance but without slip rings. We assume that when C. W. S. says "substituting copper rings" he means that he installed these rings on the ends of the rotor, connected so as to short-circuit all the windings and make the motor operate like a squirrel-cage induction motor. We also suspect, although C. W. S. does not say so, that he is starting these motors under load.

Question No. 258

Why Install a By-Pass Around a Pump Governor?

PLEASE GIVE me all the reasons why there should be a by-pass around the pump governor on each of our two new 8 by 5 by 10-in. duplex steam pumps to be used as boiler feed pumps for two 250-hp Stirling type boilers. Steam lines to the pumps are 1½ in. and the governors are 1 in. size. There are relief valves on the pump discharge lines. Is there any reason why these pump governors should *not* have by-passes around them?

Seattle, Wash. J. R. H.

Answer No. 248

How Can Boiler Operation Be Improved?

In the February issue, J. S. R. asked: (A) Should he not be getting more than 9 per cent CO_2 and less than 560 F average flue gas temperature on his two 600-hp, four-drum, bent-tube boilers, fired with Northern Illinois wash nut, 1-in. by ¼-in., on forced-draft, chain grate stokers? (B) Why does fire on one stoker burn V-shaped; that is, one side 4 or 5 ft shorter than the other? (C) Should he insulate the 16 drum-heads of these boilers, which were left uncovered when installed?

C. F. Smith, in the March issue, said the trouble was probably caused by incorrect distribution of air under the stoker and the following comments reinforce this point. They also discuss furnace and baffle leakage and are most specific in their comments on just what to look for and how to fix it.

Concerning the low CO_2 reading asked about in (A) there seems to be little doubt that this is the result of faulty introduction of combustion air. However, J. S. R. should also be sure that he is getting a representative CO_2 sample. A discussion of the importance of this appeared as Answer No. 212, September, 1943 issue.

Air Leakage and Bad Air Distribution, Says McNally

(A)—A READING of 9 per cent CO_2 is not enough in the case mentioned and an effort should be made to improve this to at least 11 or 12 per cent. Check all boiler settings to insure that there may be no leaks, thereby pulling in air from the boiler room over the fire and into the gas passages. This low CO_2 reading and high flue gas temperature may also be caused by defective baffles in the boiler, which should be remedied at once. An inspection should be made and any defects or broken baffles repaired.

The heating surfaces also should be cleaned inside and out to permit free heat transfer from furnace to water.

The gas velocity in the passages may be too great. This would greatly increase flue gas temperature and of course reduce boiler efficiency. J. S. R. does not state what evaporation per pound of coal these boilers are giving. This is an important factor in determining the cause and remedy of the trouble.

Another cause of poor CO_2 reading and high stack temperature is, no doubt, the condition of the fire burning, as shown, 5 ft shorter on one side of the grate. This will allow the hot gases to be carried rapidly through the whole heating space and tend to raise the temperature of the flue gas to an abnormal degree.

(B)—The cause of the uneven burning of this fire is apparently the air distribution. It seems that the air is being directed too much to one side of the stoker, causing the fire to burn out too rapidly on that side due, of course, to the excessive supply of oxygen. This in turn leaves a large area of grate practically free of fire and permits undesirable flow of gases.

The remedy in this case is to direct the air flow more towards the longer side of the fire until even combustion is obtained. This may be done by the louvres in the wind boxes or it may be necessary to place a brick baffle in the air passage. This must be arrived at by trial and error, according to the design of the stoker and setting.

All this, of course, is assuming that

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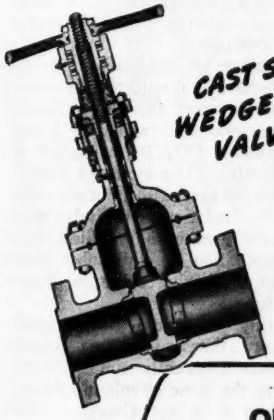

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the fire is being fed an even thickness of coal to start with.

(C)—The heads of all these boiler drums should be as heavily insulated as the rest of the boiler. In some instances, a removable sheet-metal cover, lined with asbestos, is fitted to drum heads for convenience of removal for cleaning and boiler inspection, but under no circumstances is there a reason for leaving them uncovered.

Kearny, N. J. GEO. MCNALLY

Darnell Says Faulty Air Distribution, Offers Corrective Methods

(B)—Years ago when I was a trouble shooter for a forced-draft chain grate stoker company, I encountered similar fuel bed conditions. The fact that the fuel bed is 4 to 5 ft shorter on one side is probably due to faulty air distribution, particularly if the air enters the various air compartments beneath the grate from one side only.

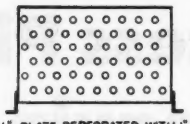
To remedy such a condition, I usually installed baffles made of perforated sheet metal. In one or two compartments directly below that portion of the fuel bed where the unburned fuel was the longest, I placed a baffle mounted on heavy angle iron feet. Rods were attached to the base so that the baffle could be pushed back and forth by reaching into the compartments from the clean-out doors. Where the air enters the compartments from one side only, the force of the blast carries more air to the far side and as a result the far side burns short while the near side has a greater length of unburned fuel. Proper adjustment of the baffles in the compartments will retard the excess air going to the far side and permit a greater volume to penetrate the fuel bed on the near side. The accompanying figure shows a type of baffle which has been used with success on some trouble jobs.

Other causes for uneven length of fuel bed may be faulty feed gate adjustment or improper tempering of coal in the stoker hopper. On several occasions I have found that uneven length of fuel bed was caused by the feed gate adjustment. Actual measurement showed that it was 1 in. to 1½ in. higher on one side than the other.

Sometimes operators attempt to temper the coal in the stoker hopper by installing water or exhaust stream sprays. Fine coal may clog the openings on one side and thereby permit the other side to receive a much greater amount of moisture. The side which is drier will not burn as readily and will therefore cause a greater length of unburned coal on the grate. Illinois and other mid-western coals should be properly tempered to obtain the best results, but such tempering should be done before the coal enters the stoker hopper.

Another possible, but less probable, cause for the uneven fuel bed may be a defective ignition arch. If this arch has spalled and broken off on one side it might cause a greater length of unburned fuel on that side.

Occasionally we find operators who



¼" PLATE, PERFORATED WITH 1" HOLES AND WELDED TO ANGLE IRON SUPPORTS. THIS BAFFLE OCCUPIES ABOUT ½ OF THE DUCT BENEATH THE STOKER.

Sketch by J. R. Darnell showing how baffle is built for stoker air compartment

are so negligent that they permit a great mass of clinker to adhere to the side wall just above the grate. Sometimes this extends out into the fuel bed like a huge finger. This causes a thinning of the fuel bed on that side, with resultant uneven distribution of burned and unburned coal.

Any of the foregoing conditions will permit a large amount of excess air to enter the system and thus cause a low CO_2 reading. Since the approximate maximum theoretical CO_2 with Illinois coal is about 18.6 per cent, a reading of 12 per cent CO_2 would be equivalent to about 53 per cent excess air, whereas 9 per cent CO_3 means 104 per cent excess air. Since J. S. R. hasn't given the per cent rating or load which his boilers are carrying, one cannot judge whether his flue gas temperature is excessive or not. Furthermore, we have no assurance that the temperature which he reports represents the true value.

Naperville, Ill. J. R. DARNELL

Answer No. 249

Why Do Slag Screen Tubes Fail in Only One Boiler?

IN ASKING this question in the February issue, T. E. H. said he had two Stirling 4-drum type boilers connected to a common steam header and fed from the same feed pump. Boilers rated at 931 hp each, 245 psi, superheat 100-120 F, feedwater at 215 F.

Each boiler had been on the line 30 days, after cleaning, when two slag screen tubes ruptured in one boiler. They were replaced, but after three weeks, nine more slag screen tubes failed, including the tubes repaired. A chalky scale showed in all tubes that failed, 1/64 to 1/16 in. thick. The boilers were producing about 58,000 lb per hr each at the time. Treatment was being maintained in their prescribed limits.

Why did these tubes fail in only one boiler, the other boiler, operating under almost identical conditions, being unaffected?

Scale, Air Leakage, High Furnace Temperature the Cause, Says R. S. Y.

MANY FACTS not given in the above question would have to be known before an intelligent answer could be given, such as:

1. Type of chemical treatment of feedwater, and where are chemicals introduced, and how distributed.

2. Analysis of boiler tube scale.

3. Comparative fuel rate in each boiler for 58,000 lb per hr load.

4. Furnace and exit CO_2, O_2 and CO, and temperatures.

5. Condition of baffles, particularly in the first pass at or near the point of failures.

Without the above facts, and by making some assumptions, certain suggestions may be made.

Assuming, for instance, that the scale is calcium sulphate, and that sodium, disodium or tri-sodium phosphate is fed into the same drum into which the feedwater enters, to sludge the calcium sulphate down as calcium phosphate, it is possible that the distribution of the phosphate is poor, resulting in spotty reaction, thereby allowing some calcium sulphate to enter the tubes as such. With all other conditions perfect, this would cause scale formation in the tubes, particularly in the tubes mentioned, where the heat is maximum and circulation most rapid. In this zone, even a light scale formation would soon cause overheating of the tube metal, resulting in bulges and blisters.

This condition may be rapidly accelerated by:

1. Openings in baffles behind these tubes allowing the gas to short-circuit, thereby concentrating considerable heat at these locations.

2. Excessive air infiltration into the settings, requiring a reduction in excess air to the furnace, thereby increasing furnace temperatures (assuming a constant maximum CO_2 is maintained at boiler gas exit). The increased temperature in the furnace will naturally cause more rapid circulation in the tubes mentioned, possibly even to a critical point where evaporation in the tubes takes place rapidly, allowing solids to deposit on tube surfaces.

Operating engineers have experienced, many times, for unexplainable reasons, that apparently similar boilers do not have the same circulating characteristics, and it is not always possible to get a good set of operating conditions by the use of standard locations for introduction of chemicals, continuous blowdown connections and sampling connections. It is suggested that these facts be considered in any future study of this problem by T. E. H.

Richmond, Va. R. S. Y.

Answer No. 250

How Stop Fuel Waste in This Unit Heater System?

IN AN INDUSTRIAL plant, two boilers supply unit heaters of 65,000 sq ft of radiation surface with 75-100 psi steam. This is the only load on the boilers. The condensate returns come back so hot that large quantities of cold water must be fed into the return lines to cool the condensate down so the pumps can handle it. This produces so much feedwater that the boilers become flooded and have to be blown down frequently, wasting a great deal of fuel.

The unit heaters and main ends, he says, are all equipped with high-pressure bucket traps. Two 250-hp boilers supply the steam; there are two vacuum pumps on the return lines with

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a preheating tank above them, vented to atmosphere. The vacuum pumps deliver the return condensate to this preheating tank, from which the boiler feed pumps take suction.

H. E. S. says several things have been suggested to stop the fuel waste: Flash tanks and heat exchangers could absorb the surplus heat; pump governors and water level controllers; pressure-reducing valves to deliver low-pressure steam to the unit heaters. He wants to know whether any or all of the above suggested remedies will cure the trouble and, if not, what is the best solution?

Schulte Had Similar Trouble, Says Look at Traps First

My experience in a plant here, which was newly opened in 1941, was similar to that of H. E. S. Except for the cost of wages to mechanics, the expense for all necessary corrections is rather small.

I went through the building, noted on a memo book all the leaky traps, had our assistants take the worst ones apart first, to clean them out and remedy the faults we found in some, besides dirt trouble. These are inverted bucket traps of four sizes, also some are equipped with the bellows air vent trap, expansion type. We have over 150 of these installed. The worst one was on the 1¼ in. return line, with a badly cracked bucket. Some had piping compound stuck on their seats, others had loosened strainers, or the cotter pins got loose and pins came out, etc.

I fixed up a testing line near the 178-hp boilers, tried all repaired traps there before returning them to the line and got to be quite an expert at finding trouble. But in two weeks' time our back pressure had dropped from 25 psi to zero. That's where most of our trouble was.

However, don't overlook the fact that dirty suction line strainers caused plenty of grief. I put 1-in. drain lines and valves on our two pumps and every 3 or 4 days we drain off a lot of sediment there, which might go into the boilers.

Other sources of trouble are leaky pump and boiler checks. They should be ground in often as necessary and convenient.

We carry the steam pressure on the day shift up to 68 psi and this goes direct into the unit heaters, which form our biggest load; reducing valves are used for various processes used in the plant. I feel glad to state these ideas have helped us to remedy our troubles and put the plant on a more efficient basis, also the boiler feed pumps are easier to maintain.

My advice, which I hope will be of some use to a fellow operating engineer, is: don't spend money for any new reducing valves, flash tanks, pumps, etc., except possibly the governors and water level controllers already suggested, which may be in already, until you try out the methods stated above.

I approve of using cold water, only as needed for makeup, in the condensate tank, before being pumped back to the boiler.

Detroit, Mich. LEO SCHULTE

Clark Says Eliminate Vacuum Pumps

IF THE unit heaters operate on 75 psi steam with bucket traps, it should be unnecessary to use vacuum pumps to return the condensate to the vent tank. It is suggested that traps from each level be piped to a common header above the vent tank. A by-pass with three valves can be arranged to allow the vacuum pumps to be used if required by pressure conditions at any time.

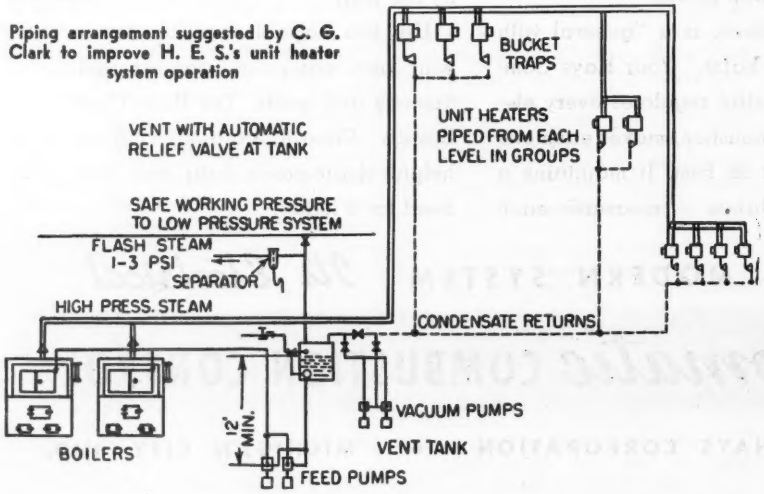
Instead of cooling the condensate with raw water, it can be allowed to flash in the vent tank. The flash steam produced can be piped through a separator to the same system now supplied by the exhaust from the feed and vacuum pumps. Make-up water can be introduced as needed into the vent tank through a float-operated valve. It is assumed that the vent tank will safely withstand the low pressure and that the low pressure system has some reliable control with a relief valve. If this is not so, a relief valve of ample size to protect the vent tank should be provided.

If no low pressure system is now in use, the flash steam can be used to heat make-up water or for other process service, at a small cost for materials.

The accompanying sketch illustrates the suggested piping arrangement. All traps should be checked for proper operation and defective units repaired or replaced. The feed pumps should be located at least 12 ft below the vent tank water level for satisfactory operation.

Saint John, N. B., Canada C. G. CLARK

Piping arrangement suggested by C. G. Clark to improve H. E. S.'s unit heater system operation



Answer No. 251

Would 220-v Motor Be Harmed by Connecting to 110-v Circuit?

WHAT HARM would result to a single-phase alternating-current motor, asked E. S. in the February issue, if it were connected to operate on a 110-v circuit?

None, Says Kendrick, Unless It Got Too Hot

IF A 220-v, alternating-current, single-phase motor were connected to a 110-v circuit, no harm would be done to the motor unless it were sufficiently loaded to cause a great reduction in the rotor speed.

Assuming that the motor is an induction type, the torque is proportional to the square of the line voltage. If the line voltage is halved, as in this case, the magnetic flux is halved and the rotor current for a given value of slip is halved. The torque of the motor is quartered, hence it would be fully loaded when only one-fourth of its normal load (i.e., the load it would carry at 220 volts) was applied. Beyond this point, if load is added, the rotor would slow down or might come to a standstill, in which case the motor would heat up. A stalled induction motor acts like a transformer with energy applied to the primary and the secondary short-circuited.

Baltimore 29, Md. JOSEPH A. KENDRICK

Benson Says Motor Would Fail to Start or Would Stall

JUST WHAT happens when a 220-v motor is connected to a 110-v circuit depends greatly upon the type of motor. Most small motors have four leads to permit their use on either 110 or 220-v by connecting the two sets of windings in parallel or series respectively, to meet the voltage conditions.

It is doubtful that a motor designed for operation on 220 v would even start on 110 v. This is usually the case when the motor is designed for split phase or teaser winding starting. When designed for repulsion starting, the armature or rotor being fitted with a commutator, the motor may start with a low torque.

Induction motors are all sensitive to voltage changes, their power output varying as the square of the applied voltage. So, if the motor started, it would only deliver one-quarter of its rated power and if overloaded slightly beyond this, the torque would drop so low as to result in the motor stopping.

Philadelphia, Pa. THOS. W. BENSON

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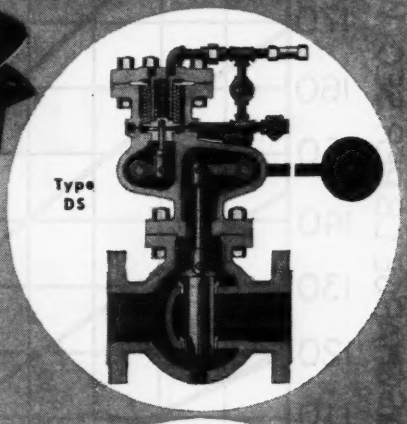
Boiler feed control properly begins at the feed pumps, through maintenance of fixed excess pressures. For this purpose it pays to specify Copes Pump Governors.

Every Copes Pump Governor is "tailored" to the specific application. This means not only selection of one of nine styles of inner valve fittings, but also design of the port area for existing flow and pressure conditions. Such individualized design results in maximum sensitivity of regulation and minimum wear.

High valve lift, close balance under flow conditions, and sturdiness are "plus" advantage that make Copes Pump Governors a sound investment.



COPES *Type DS Governor*

Service—particularly suited to turbine driven pumps.
Controlled Excess or Constant Pressure Limits—10 to 75 psi.
Sizes—¾- to 4-inch, 250- and 300-lb. stds.
Special Features—Rotating stems, weight loaded, low cost.

COPES *Type SL Governor*

Service—particularly suited to reciprocating steam driven pumps.
Controlled Excess or Constant Pressure Limits—10 to 75 psi.
Sizes—¾- to 3-inch, 250-and 300-lb. stds.
Special Features—Large 4-ply bellows, tight seating inner valve, spring loaded, moderate cost.

COPES *Type SDS-2 Governor*

Service—for severe conditions with any type of pump.
Controlled Excess or Constant Pressure Limits—15 to 150 psi.
Sizes—1½- to 6-inch, 250-lb. std. and up.
Special Features—Rotating stems, large 4-ply bellows, spring loaded, unusually responsive.

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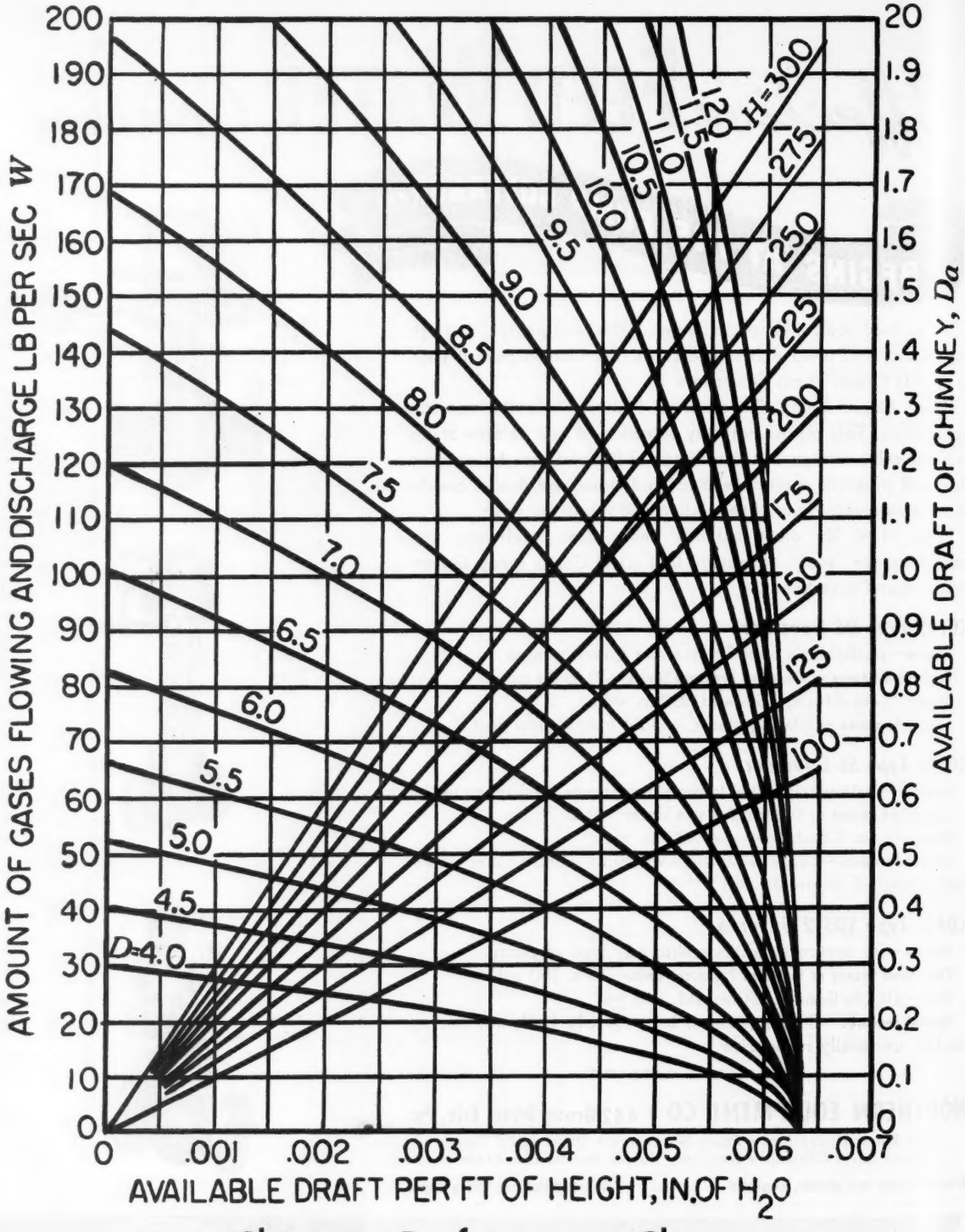


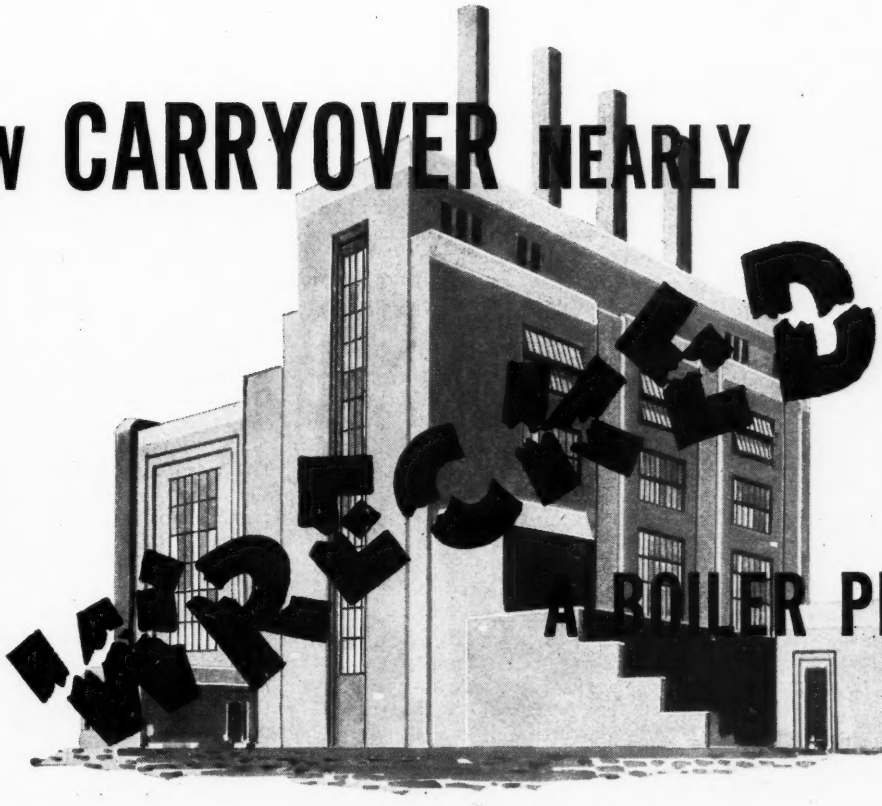
Chimney Performance Chart

This chart gives the available draft intensities for various amounts of gases flowing and sizes of chimney. The chart is based on an atmospheric temperature of 62 F, a chimney gas temperature of 500 F, a unit chimney gas weight of 0.09 lb per cu ft sea level atmospheric pressure, a coefficient of friction of 0.016, and a friction duct length equal to the height of the chimney above the grate level.

To solve a typical example, proceed horizontally from a Weight Flow Rate to intersection with diameter (D) line; from this intersection follow vertically to chimney height (H) line; from this intersection follow horizontally to the right to Available Draft scale. Starting from a point of available draft, take steps in reverse order.

Chart, presented by permission, American Society of Heating & Ventilating Engineers

HOW CARRYOVER NEARLY WRECKED A BOILER PLANT!



A large mid-western oil refinery, generating 2,000,000 lbs. of steam per day, was plagued with a serious carryover condition which was working havoc on superheater tubes, turbine blades, steam lines, valves and traps. An attempt to minimize carryover by maintaining the almost unbelievable blowdown rate of 25% failed to correct the condition; superheater tubes continued to burn out so rapidly that the superheaters were removed in a final effort to keep boilers on the line... but to no avail.

W. H. & L. D. BETZ engineers were called in to make a complete plant study. Recommendations were quickly made which entirely eliminated carryover and the abnormally high blowdown rate of 25% was reduced to 8%. Superheaters were re-installed and after eighteen months of operation *not one tube has failed.* Boilers now remain on the line from twelve to fifteen months with boiler efficiency stepped up and production rates increased through the elimination of "bad steam".

An exceptional case? Not at all. It is typical of the services rendered to industry by W. H. & L. D. BETZ. It illustrates how the facilities of this nationwide organization of chemical engineers and consultants are being employed to solve problems relating to the conditioning and correction of boiler feed water.

● CHEMICAL ENGINEERS AND CONSULTANTS ON ALL WATER PROBLEMS

W. H. & L. D. BETZ

FRANKFORD • PHILADELPHIA • PENNA.

Bayside—Simple and Progressive in 1943 as in 1927

(*Continued from Page* 69)

was necessary only to install two new traveling screens in the screen house, which was suitably enlarged for them. Also, chlorinating equipment was installed to chlorinate circulating water for all three units at the traveling screens. This follows the practice used in recent years by many plants for preventing organic growths in the circulating system.

Because of an unforeseen and unpreventable occurrence in 1940, when a freak storm blew most of the water out of the forebay, the condenser water intake channel from forebay to screen house was dredged two feet deeper when Unit No. 3 was being installed. If a fourth unit is added later, this intake channel will be made still deeper.

Electrical Features

In the original 1927 Bayside Station, the electrical features were, like the mechanical, progressive for that day but not untried or experimental and the layout was kept simple. Units Nos. 1 and 2 were directly connected to a 14-kv bus, with power stepped up directly to 66-kv in the outdoor substation by a bank of 28,125-kva transformers. A 66-kv bus in the substation formed part of the 66-kv circuit serving the territory around Green Bay and De Pere.

This original electrical design more or less determined that for Unit No. 3, keeping the electrical features simple as before. A new 14-kv bus was installed, to which the new unit is connected. The new bus is connected to the existing 14-kv bus through a tie switch. Power from the new bus is stepped up to 66-kv by a bank of transformers of 36,000-kva capacity, the outgoing side of which is connected to the old 66-kv bus, forming a two-section ring bus. From this the transmission lines run out to the system, one going to a connection with a 110-kv line at Stevens Point, Wis. These connections are shown in Fig. 8. The existing plant connects to the 66-kv bus at one point, the new plant at another, with breakers on either side of the junction points. Thus, if one section of the bus is in trouble, the generators will stay connected to the other and the 66-kv loop around Green Bay, as well as other loops having two sources of power, can be fed from either side of the ring bus. Lines leading away from the ring bus are protected by pilot wire relays or high-speed distance type relays.

Two-Section Auxiliary Bus

Another interesting new feature on Unit No. 3 is the division of station auxiliaries into two groups, as shown in Fig. 9, connected to the 2300-v auxiliary bus in such a way that failure of one section of the bus will not cause complete shut-down of the generating unit. The 2300-v bus is divided into two sections connected through the breaker 7. Forced and induced draft fans of Unit No. 3 are connected to both sections with automatic throwover devices. If one side of the bus gets into trouble, the fans are automatically thrown over to the other side. Each of the two pulverizer driving motors is connected to opposite sections of the bus, as are also the two circulating pump motors and the two electrically driven boiler feed pump motors.

In detail, the fan motors are normally connected to the bus through breakers 9 and 10. Breaker 1 is normally open, breakers 7 and 17 normally closed. If the right hand side of the bus is in trouble, breakers 2 and 3 will close after breakers 7 and 14 have opened. Breakers 9 and 10 will open after 2 and 3 have closed and breaker 1 will close after 9 and 10 have opened. The right hand section of the bus will now have been cleared and the left side connected to the reserve power supply, thus allowing operation to continue on one pulverizer, one circulating water pump and one boiler feed pump, with the forced and induced draft fans continuing as before.

Sectionalized 230-v Auxiliary Bus

A similar arrangement of sectionalized bus for the 230-v auxiliaries is used, as shown on Fig. 11. The 230-v main bus No. 1 and main bus No. 2 are both fed from 230-v station power transformer banks Nos. 1 and 2 respectively, and a different group of auxiliaries is connected to each bus. Two emergency buses, fed from the emergency power transformer bank are connected by tie breakers to the Nos. 1 and 2 main 230-v bus in such a way that the motors connected to a main bus can be fed from the emergency buses or vice versa. Also, certain of the 230-v auxiliaries have automatic throwover devices to connect them to either section of the main or emergency bus if the other is in trouble.

New Control Equipment

In the 1943 extension, an entirely new station electrical control room was built, located as shown on Figs. 1 and 4. Figure 11 shows the new main station control benchboard in the new control room.

A complete new boiler control panel for the new unit was installed on the operating floor near the control panels for the old boilers, as shown on Fig. 1. Here all the boiler control operations, both automatic and manual, are centralized, in accordance with the latest practice.

The control panel for the new 30,000 kw turbine was installed on the operating floor near the head end of the turbine, Fig. 7.

All station piping is welded. The main high pressure header is 10-in. carbon-molybdenum steel pipe, shop fabricated, with the valves and long sections flanged. The superheater also was shop welded, so that only U-bends had to be welded in place.

As a result of the features described, combined with careful attention to all details of operation, the new Bayside Unit No. 3 is expected to have a heat rate of 12,000 Btu per kilowatthour net sendout.

Acknowledgments

Design of the new Bayside Unit No. 3 was carried out by Public Service Utilities & Engineering Co. of Chicago. Mechanical engineering was in charge of H. S. Whiton and electrical design was supervised by H. W. Eales.

For the heartiest cooperation in visiting the Bayside Station and obtaining data on the new Unit No. 3, we are indebted to A. G. Carson, vice-president and chief engineer of Wisconsin Public Service Corp., who held the same office when the editor visited Bayside in 1927 and offered the same cordial cooperation at that time. To W. F. Nelson, mechanical engineer of Wisconsin Public Service Corp., the editor is especially indebted for furnishing data and explaining the equipment in the station, also to M. F. Brooks, chief operating engineer of Bayside, to G. J. Morrison, results engineer, to Dale Remington, of the company, who took the official photographs, and others. O. J. Hannas was superintendent of construction for the new Unit No. 3.

SMOOTH

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Welding Fittings and Flanges

The Gas Turbine—

Present Status and Immediate Prospects

(*Continued from page 75*)

elasticity in the structures to compensate for temperature variations. The successful achievement of heat-elastic design is appreciably simplified when the power plant is subdivided into multiple expansions.

Cylinder Design and Bolting

Complete symmetry of turbine cylinder design appears highly desirable, which suggests that eventually the horizontal joint should be eliminated. This problem requires a high order of imagination and success will probably depend on the degree to which the established conventions of steam turbine design can be disregarded.

The bolting problem is indicated to be a major source of difficulty, and thread fits, as well as galling properties of the materials, will bear watching. Anti-galling compounds of real merit have been developed, however. Means for the elimination of galling between all breathing surfaces must be provided.

The compressor will probably require the greatest share of new developments, although the progress in recent years has been very promising. Centrifugal and axial-flow compressor characteristics place severe limitations on the application of this type, and, if a fully satisfactory constant-displacement compressor can be developed, it may eventually replace the other types.

Most of the experience gained in the field of combustion of liquid fuel is applicable, and a satisfactory combustion chamber seems to be in sight. Due to the large amount of excess air, practically smokeless combustion over wide ranges of load may be expected.

Except for the arrangements incidental to starting, no control valves of the air circuit should be required. All ordinary control will be centered in the fuel circuit, and the type of mechanism involved here has now a long history of satisfactory performance.

The piping and duct problem, on the other hand, may be expected to play an important role in gas turbine plants, due to the necessity of compact layouts and the extremes of thermal expansion. Special expansion joints and similar devices are imperative. The low operating pressures offer a measure of relief, but the pressure drops through the piping must be kept much smaller than in steam plants, since they constitute a more direct drag on the overall efficiency.

Weight and Space Requirements

It is too early to present conclusive figures on the weight of gas turbine plants, but the following tentative estimates have been made for plants operating at 1200 F. Because of the relative simplicity of the turbine structures it is anticipated that their weight will range from 2 to 3 lb per turbine horsepower. The compressors are less easily rationalized, but a range of from 2 to 6 lb per compressor horsepower appears reasonable. The regenerator may be expected to weigh from 1 to 1.6 lb per sq ft. Combustion chambers, intercoolers, miscellaneous piping, ductwork, insulation and auxiliaries are not expected to exceed 2 lb per turbine horsepower. On this basis, the weight of the complete plant may be approximated by the following relation:

$$\text{Weight of plant per hp} = \frac{2 \text{ to } 3}{a} + 2 \text{ to } 6\,\frac{1-a}{a} + 1 \text{ to } 1.6\,\frac{F}{P} + \frac{2}{a}$$

For a typical plant whose work ratio is 0.4, operating at 1200 F and delivering about 2500 hp, a specific weight of less than 25 lb per hp, exclusive of the drive, appears to be a conservative estimate. Considerably lower weights could be obtained with less conservative designs. Even this figure, however, is the equal of the lighter Diesel plants and is considerably lower than common steam practice.

No reliable conclusions can be drawn regarding the space required, but for the typical plant just referred to, one cubic foot per turbine horsepower appears to be a reasonable estimate.

Size Limitations

Until the premises of high-temperature design have been verified by operating experience, it is not to be expected that gas turbines exceeding 7500 hp will be constructed. Progress that can take place after the verification of these premises is tied in with the ability to produce the new alloys in large forgings, as well as with the ability of the designers to overcome expansion and other problems.

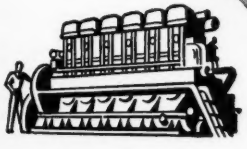
Fuel and Lubricating Oil

For a period of time at least, it is anticipated that most gas turbine plants will operate on volatile ash-free fuels of the distillate type. Fundamentally, there appears to be no objection to the consideration of heavier grades of oil, with powdered coal as an eventual, perhaps remote, possibility. It is certain that with thermal efficiencies of 30 per cent or more, which appear immediately attainable, a great deal of effort will be expended in achieving operation with the cheaper fuels. With the price of Bunker C fuel at two-thirds of that of Diesel oil, the economic possibilities of the gas turbine appear very attractive.

The lubricating oil problem in so far as quality is concerned is not anticipated to be more severe than that encountered in Diesel practice. In so far as quantity is concerned, however, the lubricating-oil consumption of gas turbines falls in the class of steam turbines.

Conclusion

It will be apparent from the foregoing that the gas turbine is by no means a purely utopian scheme of power generation, and that it has possibilities worthy of development. Limiting the operating temperature to 1200 F, and using the reheat type of cycle, it is possible to attain a fuel consumption (Bunker C) of about 0.45 lb per hp-hr with a plant weighing less than 25 lb per hp exclusive of generators or other power-absorbing equipment. The development will involve many difficult engineering problems, but none of them appears to be beyond attainment with the present metallurgical materials. Further advances in the metallurgy of high-temperature alloys, and further elaboration of the gas turbine cycle, will make it possible to realize fuel rates of less than 0.40 lb per hp-hr. The maximum size of gas turbine plant which can be constructed at the present time is somewhat difficult of prediction, but 7500 hp appears possible. The reliability of such gas turbine plants is expected to be fully satisfactory, once the early development problems have been solved. The maintenance expense should compare favorably with that of present-day steam plants.



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BALDWIN
DIESEL ENGINES

—a newspaper editorial,
January 14, 1944
MILITARY SECRET
FROM 130 B. C.
The jet propulsion plane apparently is a rocket plane without the fire and smoke. The invention, no doubt, will be credited to modern day science and ingenuity, altho the greatest wonder about jet propulsion is that mankind has let the idea kick around for so long without putting it to use.
If you want a picture of the first jet propulsion motor, flip the pages of the dictionary to the word aeolipile. The aeolipile was the first steam engine, and it was jet propulsion, pure and simple. Hero of Alexandria, a Greek mathematician and physicist, about whom little is known except that he probably lived about 130 B. C., invented or gave the first account of the aeolipile.
It is a metal basin with a cover, standing on a tripod. Hollow tubes lead up from the basin or boiler to a metal sphere, which is mounted so that it can revolve. Two jets protrude from opposite sides of this sphere, with their tips turned at a tangent to the sphere, like the arms of a swastika. Put some water in the basin, build a fire beneath it, and the steam whistles out of the jets, spinning the ball.
Men have learned to do a lot of things with steam since Hero's time, but it took them more than 2,000 years to realize that Hero had something in jet propulsion.

GLAD TO SEND YOU A RICH WOODCUT PRINT SHOWING THE ORIGINAL USE OF JET PROPULSION BY HERO OF ALEXANDRIA, 130 B.C.

The announcement of the new jet-propelled mystery war plane—unspeakably fast and powerful—just gives more proof to those old-timers who stick to the idea that there is nothing new under the sun.

A Chicago newspaper in an editorial late in January traced the idea to Hero of Alexandria and dated its first use as 130 B.C.—in what is often called the original steam engine.

READING-PRATT & CADY's research ran across the story about five years ago—and a very early drawing of the steam engine. We located an old-time woodcut craftsman and asked him to reproduce the ancient sketch.

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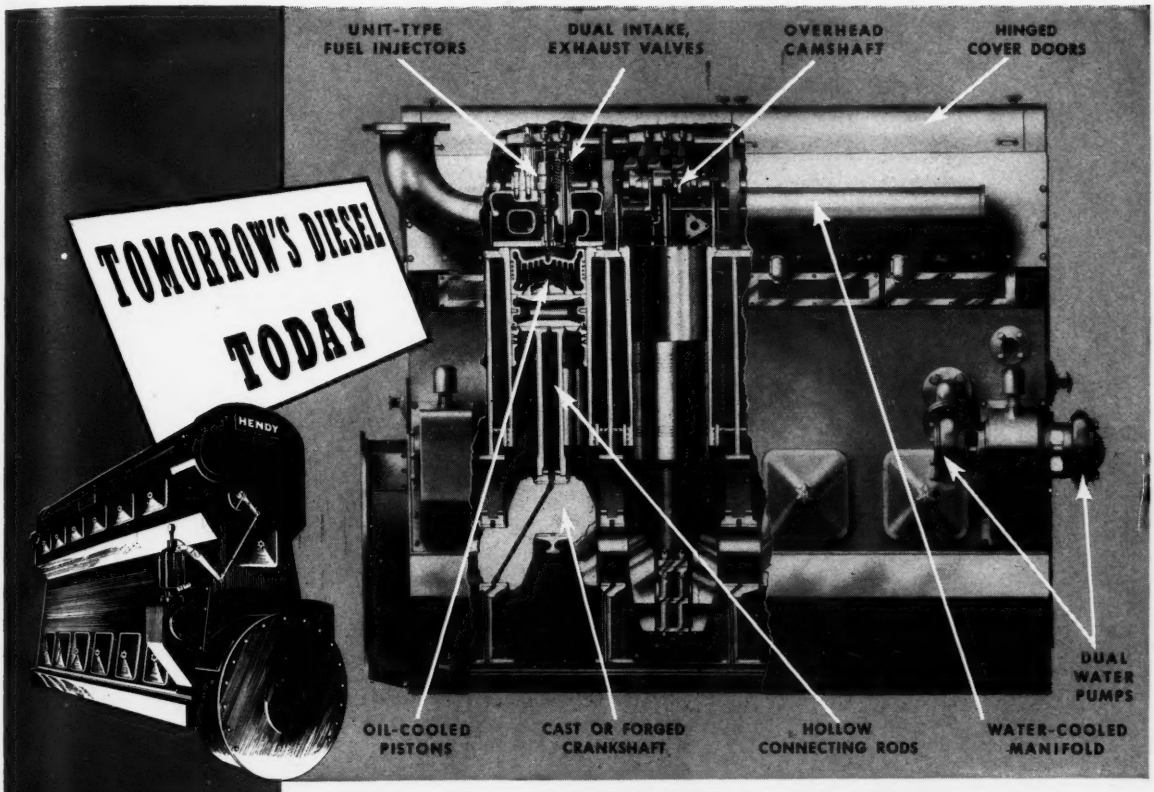

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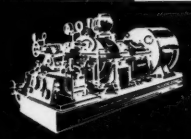
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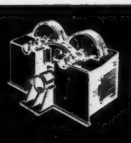
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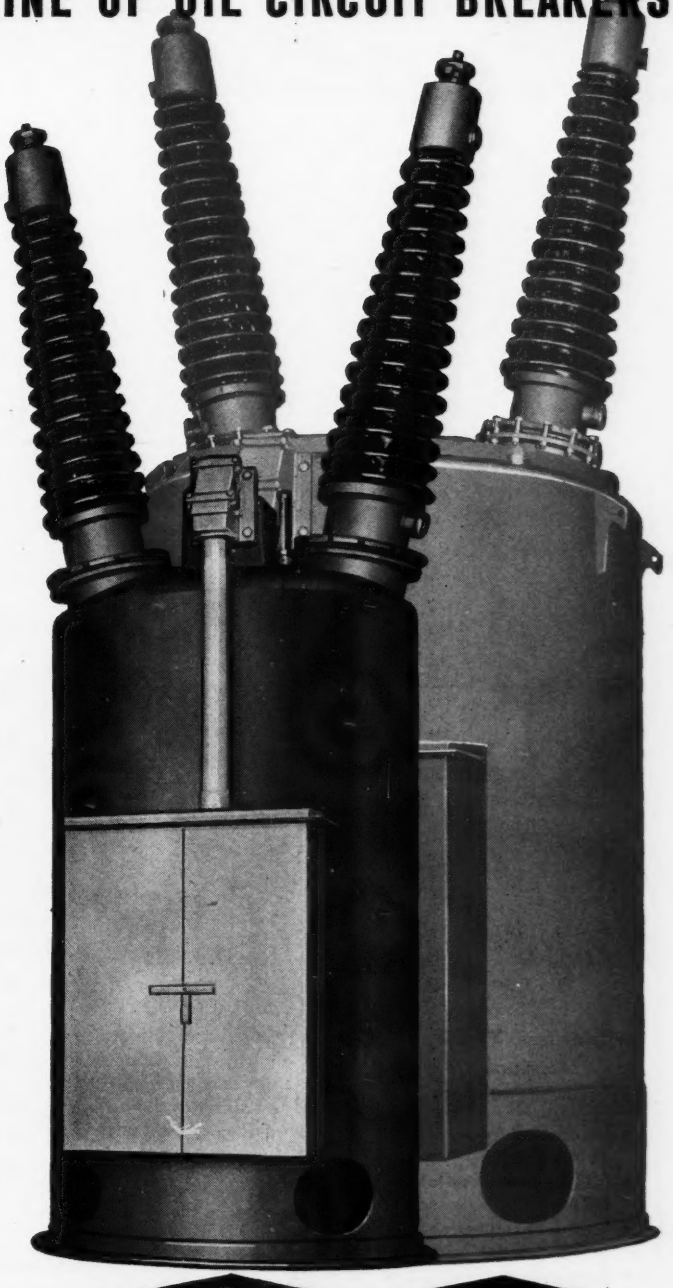

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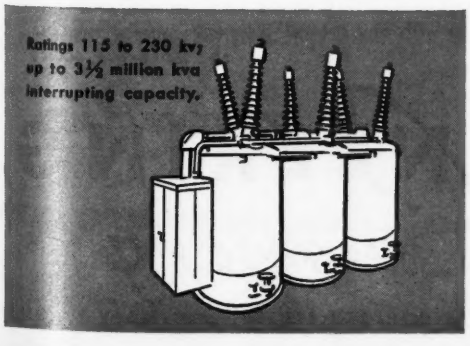

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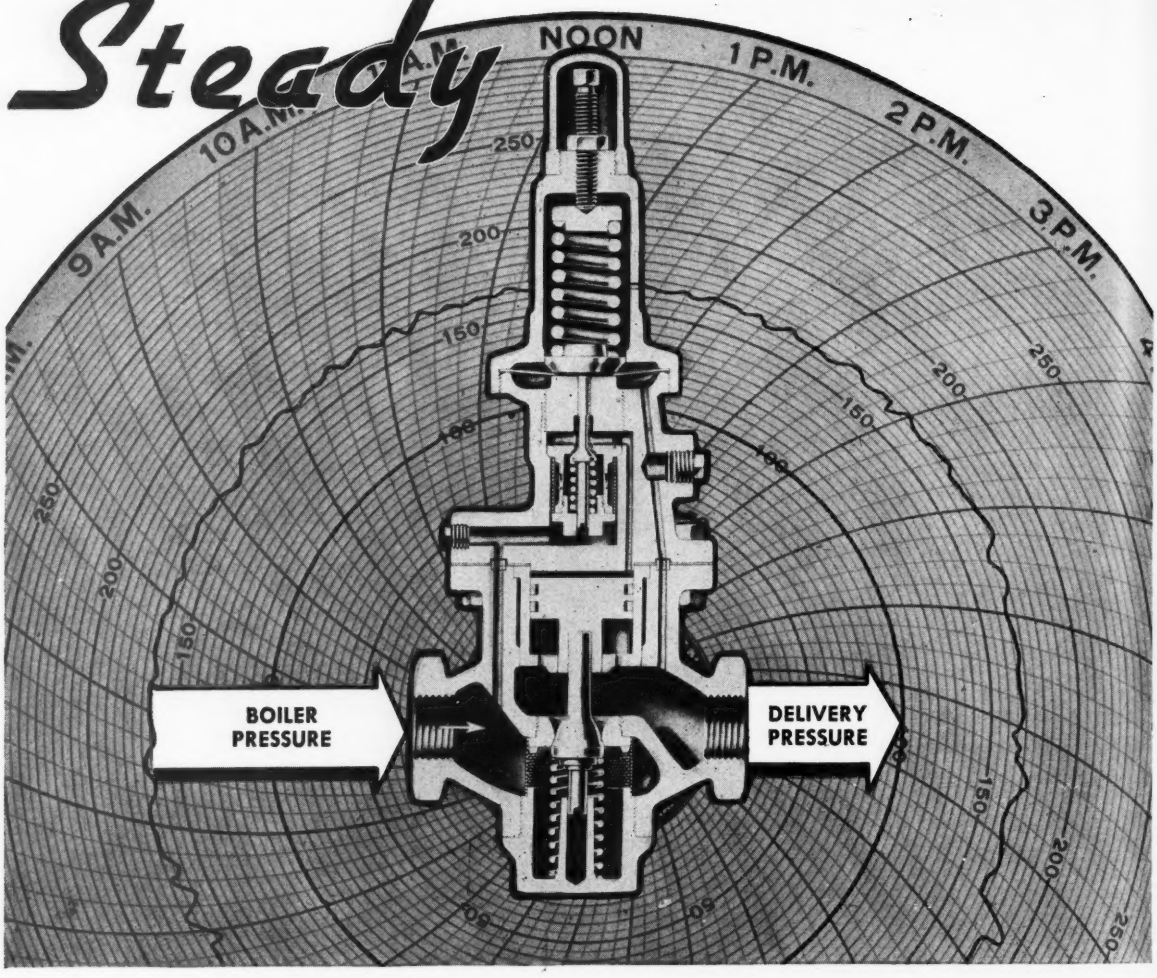

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- Wide variety of spring ranges
- Alloys to suit pressures and temperatures

. . . with minimum maintenance. For instance, in one plant where twenty Foster Automatic Valves have been in service for fourteen years, no major repair jobs have yet been necessary. A few springs and diaphragms have been replaced, and valves have been ground according to schedule—but that's all.

And for *scheduled* maintenance, auxiliary valve units are INTERCHANGEABLE for all Type 37-G2 valves from one half to four inches, which *greatly speeds routine replacements*. Larger sizes also have this feature.

There are many other built in features which provide for quick servicing and checking of parts subject to wear. These features are illustrated in Foster Catalog 70, which also gives you answers to many of your regulation problems. In addition, our engineering staff will be glad to assist you with any *special* problems.

Illustrated catalog on the complete Foster line, with many pages of useful engineering data will be sent if the request is made on company letterhead. Simply ask for Catalog 70.

★

HELP SHORTEN THE WAR
BUY MORE WAR BONDS

FOSTER ENGINEERING Company

PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

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DETRICK *sees it through!*

WHETHER it is an ordinary boiler furnace or a complicated new chemical process, Detrick can be relied upon to see to it that the furnace enclosure functions properly. In the field as on the drawing board Detrick engineers have gained a reputation for thoroughness, originality and the type of direction that gets things done.

Proof of this statement lies in the thousands of Detrick Walls and Arches that are today giving excellent service under conditions far more severe than originally contemplated by their designers.

A new 80-page book describes the construction principles learned during 30 years of concentrating on the problems of enclosing heat. Ask for your copy of "DETRICK FURNACE ENCLOSURES."

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MODERNIZE NOW

Now's the time to check up your furnace walls and arches. Be sure they are ready for the job ahead. Any repairs and modernizing should be done at once. A Detrick inspection now may avoid costly production delays later.

DETRICK

USE DETRICK INSULATION . . . PLASTIC or BLOCK

Insignia of Strength and Service in Power Piping

NAVCO

NAVCO PIPING

NATIONAL VALVE & MFG. CO., Pittsburgh, Pa.

ATLANTA • BUFFALO • CLEVELAND • CHICAGO • NEW YORK • PHILADELPHIA

"IN 6 MONTHS THIS VOLTAGE REGULATOR PAID FOR ITSELF TWICE OVER IN SAVINGS IN PAPER AND MAN-HOURS"

. . . reports blueprint-machine user

3.6-kva, automatic, induction voltage regulator (Control panel is mounted separately.)

PROBLEM A large Midwestern plant was experiencing considerable trouble in its blueprinting department because of fluctuating voltage. This poor voltage condition was caused by a varying power and lighting load. The high-intensity, mercury-vapor lamps being used in blueprinting were burning out needlessly. Large quantities of blueprint paper were being wasted because it was necessary to make trial prints at various times of the day to determine proper exposure. There was also a waste when making microfilm records of large-size prints, because varying voltage caused a varying intensity of light and, hence, underexposure or overexposure.

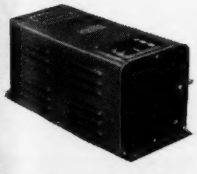
SOLUTION No *special* equipment was needed to lick the problem. General Electric engineers suggested two 3.6-kva, 240-volt, automatic, dry-type, induction voltage regulators, selected from our standard AIRS line.

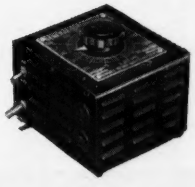
RESULTS Now, after less than six months, the manufacturer reports that these *automatic* regulators have already paid for themselves at least twice—in materials plus man-hours saved. Under the old setup, it was necessary to adjust the voltage by hand several times a day.

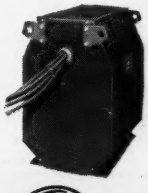
WHAT'S YOUR PROBLEM? Pepless motors, poor lighting, uncertain test results, and production slumps are often the result of poor voltage. Whether you need voltage control for a vacuum tube or a power shovel, there's a simple, economical G-E device for the job. *General Electric Company, Schenectady 5, N. Y.*

OTHER G-E AIDS TO BETTER VOLTAGE

VOLTAGE STABILIZER—Automatically provides a constant 115-volt supply to a given load, on circuits varying from 95 to 130 volts. Ratings from 50 to 5000 va. Ideal for precision laboratory or manufacturing processes, or built into such equipment as radio transmitters. **VARIABLE-VOLTAGE AUTO-TRANSFORMER**—Provides smooth, adjustable control of voltage, current, light, temperature, power, and speed at a turn of the dial. Ratings from 243 to 810 va. Ideal for use in factories, laboratories, and assembled with other equipment. **TYPE D TRANSFORMER**—For insulating lighting circuits, reducing light flicker, boosting or stepping down voltage for the most economical operation of motors, welding equipment, etc. Ratings up to 100 kva, 600 volts.







THE RIGHT VOLTAGE AT THE RIGHT PLACE DOES THE JOB BETTER

BUY WAR BONDS

GENERAL ELECTRIC

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5400

KENNEDY
IRON-BODY WEDGE GATE VALVES

Convenience Features . . .

- Simple design assures easy, correct assembly.
- Large handwheel for ample leverage.
- Slotted gland top for quick release from stuffing box bolts.
- Shelves on yoke to hold gland well out of way for repacking.
- Swing stuffing box bolts drop out of the way on non-rising stem valves.
- Chain wrench lugs on screwed-end valves.
- Washer type nuts at stuffing box eliminate loss of washers.
- Every bolt accessible to a standard open wrench.

The metal used in these valves is 50% stronger than ordinary cast iron...one of many other Kennedy Iron-Body Wedge Gate Valve features. Catalog upon request.

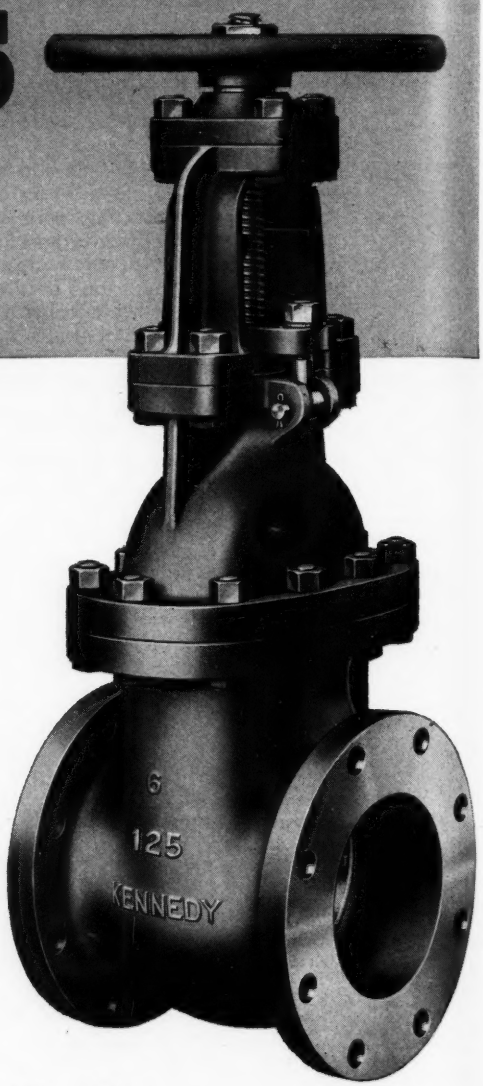


Fig. 061
Standard Flanged O.S. & Y
Iron Body Wedge Gate Valve

THE KENNEDY VALVE MFG. CO. • ELMIRA, N.Y.

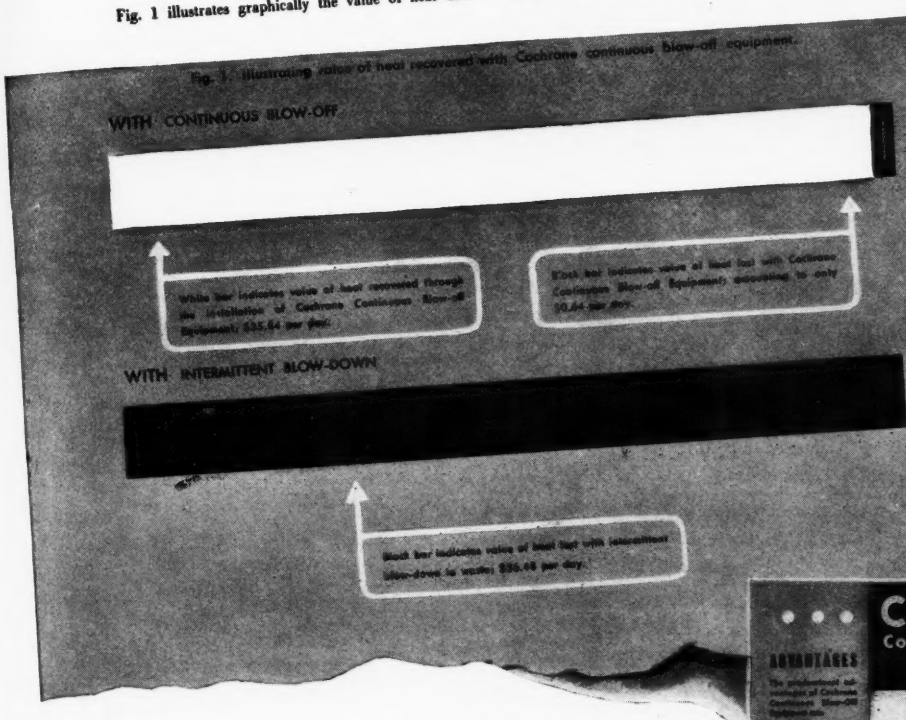
HEAT SAVINGS

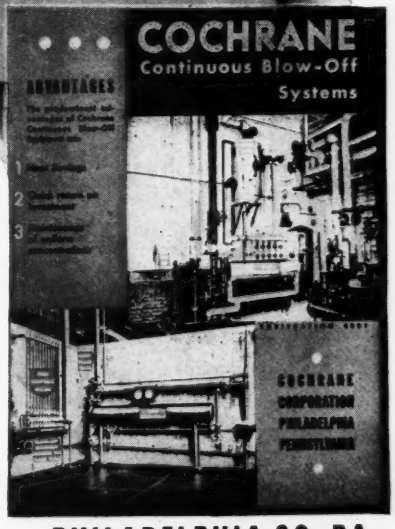
The installation of Cochrane continuous blow-off equipment recovers practically all of the heat in the water, the only heat wasted being that which corresponds to the thermal difference between the incoming cooling water and the blow-off water going to the sewer.

Fig. 1 illustrates graphically the value of heat that would otherwise be lost with intermittent blow-down and the saving that would be brought about by the installation of heat transfer equipment.

The saving brought about by this installation is such that in most cases the cost of the equipment can be realized in a year's time giving a return of 100% on the investment.

Fig. 1. Illustrating value of heat recovered with Cochrane continuous blow-off equipment.


WITH CONTINUOUS BLOW-OFF
White bar indicates value of heat recovered through the installation of Cochrane Continuous Blow-off Equipment; $35.64 per day.
Black bar indicates value of heat lost with Cochrane Continuous Blow-off Equipment; amounting to only $0.64 per day.
WITH INTERMITTENT BLOW-DOWN
Black bar indicates value of heat lost with intermittent blow-down in water; $36.48 per day.



ABOVE is a page from the new Cochrane Publication No. 4081 on Continuous Blow-Off Systems. The example of savings shown on this page is not at all exaggerated but is based on a representative problem in boiler blow-down. In installation after installation the cost of the Cochrane Continuous Blow-Off System is recovered so quickly that *net* savings often begin inside of a year.

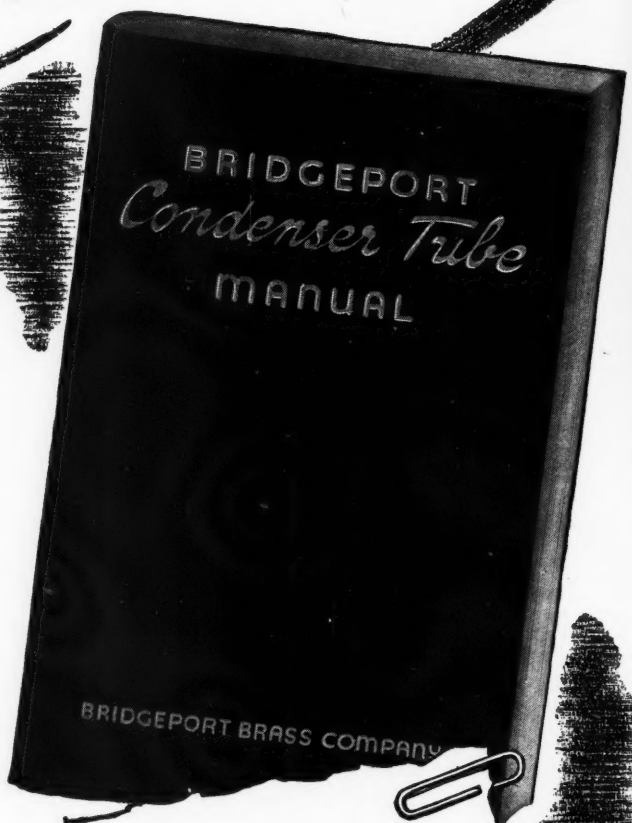
This comprehensive bulletin on the subject of Continuous Blow-Off is just off the press. It will pay you to go over it and see if your present system of boiler blow-down is not wasting money. Write for Publication 4081.

COCHRANE CORPORATION 3123 N. 17th Street PHILADELPHIA 32, PA.

COCHRANE

SOFTENERS · DEAERATING SOFTENERS · DEAERATORS · METERS · STEAM SPECIALTIES

This New Technical Booklet
SHOULD BE IN THE HANDS OF
Every Engineer and Technician
CONCERNED WITH THE
Selection and Maintenance of Tubing



Much new and heretofore unpublished information on copper-base alloys that should be of great help to everyone concerned with the selection and maintenance of tubing for installations in condensers, heat exchangers, evaporators and for general piping.

The manual deals with comparatively new and more corrosion-resisting alloys, such as Duronze IV, Cupro Nickel, Cuzinal, as well as improved Admiralty, Muntz, and Copper.

A special feature is the section devoted to a detailed discussion on corrosion which has been digested from technical reports covering extensive tests conducted by Bridgeport over many years. Among the subjects covered are the effects of film deposits, oxygen and debris, impingement corrosion, galvanic corrosion and protection, influences of temperature, water composition and rate of flow, and presence of minerals, carbon dioxide and sulphur. Stress corrosion and corrosion fatigue are also discussed.

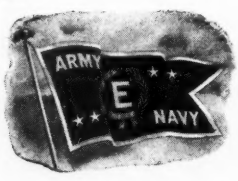
The manual contains the latest A. S. T. M. and Federal Specifications on standard alloys, comprehensive weight tables, steam notes, methods of installing and packing, cutting and removing condenser tubes. It also contains weight tables and data on brass and copper pipe, copper water tubing and navy type copper tubing.

Send your request on company stationery.

HANDY, POCKET-SIZE
112 PAGES, 39 PHOTOGRAPHS
29 DIAGRAMS, 23 TABLES

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.



ESTABLISHED 1865

THIS ONE IS REALLY SPECIAL!

Another example of Taylor Forge "know-how" that means extra value in WeldELLS

• *They don't come much more special than this fitting: Special material . . . carbon-moly. Special size . . . 9". Special wall thickness . . . 0.542". Special design . . . integrally formed 3" side outlet.*

But special though it is, it is simply typical of the problems that are so frequently put up to us by those who have found that we can solve them right.

Yes, doing the *unusual:* In our regular line of WeldELLS and other Taylor Forge welding fittings we have done the unusual. Into WeldELLS has gone the knowledge acquired in performing just about every conceivable kind of forging operation; knowledge of controlling hot metal under pressure and impact; knowledge that was full-grown long before welding fittings were ever produced on a commercial scale.

This is reflected in WeldELLS in features like extra metal properly distributed where stresses are greatest . . . in the tangents . . . in the extremely accurate dimensions . . . in the features, listed opposite, that are combined in no other welding fittings. Check over this list, and we believe you will agree that

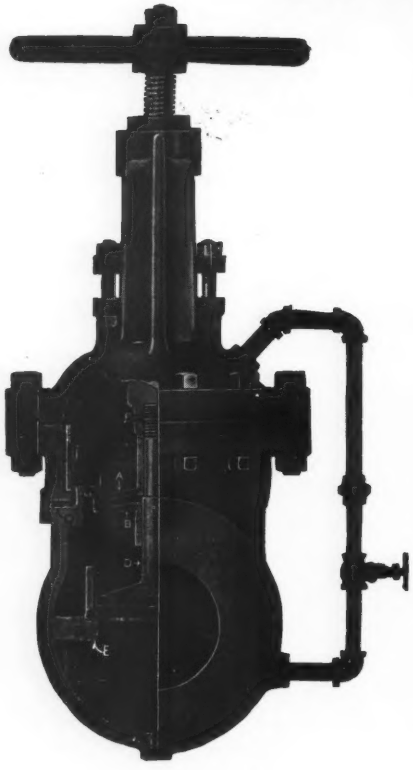
WeldELLS have everything

WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

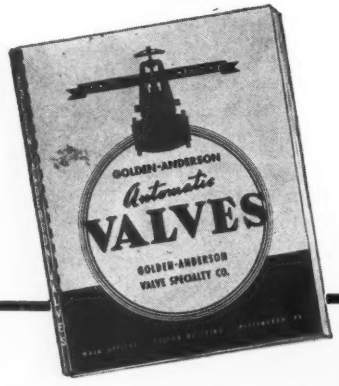
Golden Anderson SPECIALTY VALVES



Here is instantaneous automatic protection against runaway engines and turbines

• **The Golden-Anderson Throttle and Emergency Stop Valve shown here offers positive protection against runaway engines and turbines. It works instantly . . . mechanically, electrically, by hand or remote control. No unit can exceed safe operating speed when equipped with this unit.**

The valve is supplied in angle and globe patterns from 2½" to 16" sizes. Valve trim may be bronze, monel, stainless steel or Gallavoy, according to pressure and temperature conditions. Seat rings and disc may be stellited.



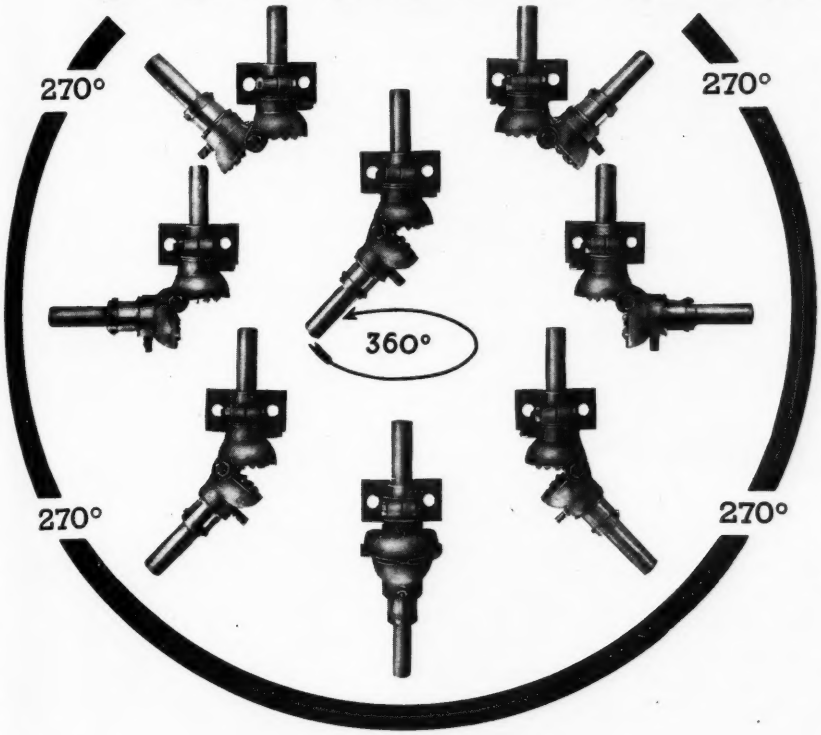
Write today for this catalog . . . describes the complete line of G-A Specialty Valves.

GOLDEN-ANDERSON VALVE SPECIALTY CO.

FULTON BLDG. • • • PITTSBURGH, PA.

This UNIVERSAL JOINT *Gives You*

50% GREATER USEFUL RANGE



For

Remote Control of Inaccessible

- Valves
- Pumps
- Engines
- Equipment

— and for centralized control of widely separated units.

- Positive transmission of torsion through 270°
- Precision cut manganese bronze gears, 100.000 psi
- Back lash held to approximately .005"—less than ½°
- Housings cast brass—shafts CR steel
- Sizes ½" to 1½" standard. Special sizes to order
- Brackets and Shaft Hangers to match.

Illustrated Bulletin giving technical data on these Universal Joints, Shaft Hangers and Brackets is now available. Ask for Bulletin CS-10.

Condenser Service
AND ENGINEERING CO., INC.

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NEW JERSEY TELEPHONE—HOBOKEN 3-4425

NEW YORK TELEPHONE—RECTOR 2-9360 AFTER 6 P. M. AND SUNDAYS—HOBOKEN 3-4428

4-CS-4

We Didn't Want to Make Strainers

BUT we needed them for use with Yarway Steam Equipment and couldn't find any to suit us.

So we designed the *YARWAY Strainer.*

Apparently a lot of other people were having "Strainer trouble" because, without a line of advertising, the Yarway Strainers *purchased* in a few years now number *many thousands.*

Why don't you look into this better Strainer for your money? Buy one from your supply house (over 100 Mill Supply Houses now have them).

See its protection against corrosion—*cadmium plating inside and out.*

Examine its *high grade Monel woven wire screen* that stops dirt—lets condensate or other fluids flow freely.

Notice the removeable blow-off bushing. Screen and bushing come out together—go back together, *automatically aligning.*

Six standard sizes from ½" to 2" for pressures to 600 lb.

See your Mill Supply House or write for Bulletin S-200

YARNALL-WARING COMPANY
114 Mermaid Ave. PHILADELPHIA 18, PA.

YARWAY STRAINERS

Reinforced Concrete Pipe*

By Wm. A. Shelton
American Concrete and Steel Pipe Co., Los Angeles

STEEL PIPE was first considered for these circulating water tunnels in the construction of the Harbor Steam Plant for the Department of Water and Power, City of Los Angeles, Cal., but due to war conditions, this had to be abandoned in favor of reinforced steel concrete pipe. Tests have shown the concrete pipes to be 10 per cent cheaper than steel pipe, saving essential war material, much quicker delivery and probably longer life in sea water.

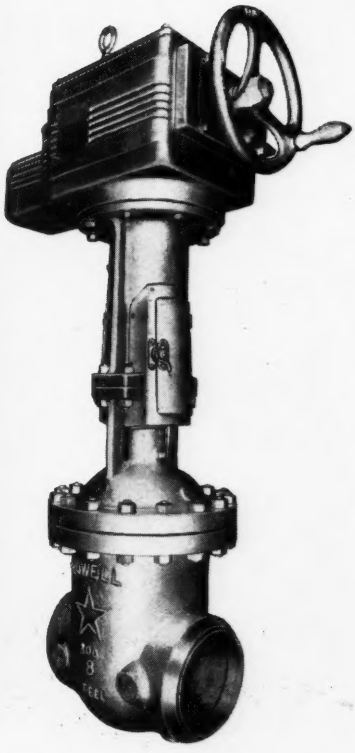
One of the most important items in the making of the pipe was the steel cages for reinforcing the concrete. These cages were made by first winding ⅝-in. plain reinforcing steel on mandrel and welding to horizontal spacers; then the rod ends were welded together to additional ½-in. horizontal spacers. Where welded bars were used for transverse reinforcement, each weld had to test to a stress of 40,000 psi of bar.

Preparation for Pouring Concrete

In preparation for pouring the concrete, these cages were lowered over inside steel form, then the outside steel form is lowered over the cage and tightly closed. The forms in which the concrete pipes were cast consisted of an inner and outer steel form, a fabricated metal bottom ring and steel top ring. The inner and outer forms were welded of 8-gage sheet and were of sufficient thickness to prevent distortion when the concrete was poured. It was necessary that

*This was a prize winning article in the Hobart Arc Welding News Contest conducted by the Hobart Brothers Co., Troy, O. through whose courtesy the data and photo are published.

POWELL PERFORMANCE IS PRE-DETERMINED

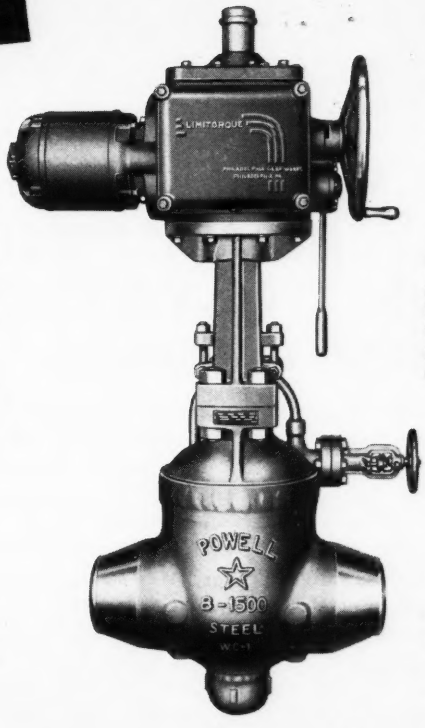


Class 300-pound, 8-inch Cast Steel Gate Valve with welding ends and bolted bonnet. It is equipped with a top-mounted electric operator for fast, safe, efficient operation.

We are always ready and willing to give you advice on the care and maintenance of your valves. But valve failures are not always due to lack of knowledge—or neglect.

In countless instances valves fail to perform as they should because they're not of correct design and material for the services in which they are installed.

By consulting POWELL Engineering *first* you can avoid these failures because *Powell performance is pre-determined* — by experts.



The valves shown are examples of the complete POWELL Line of Cast Steel Valves, built especially to meet the flow control requirements of the Power Plant of today—and TO-MORROW.

Class 1500-pound, 8-inch Cast Steel Gate Valve with welding ends, welded bonnet, special by-pass and welded sediment and inspection cap. Equipped with a top-mounted electric motor operator for quick, positive opening and closing.

The Wm. Powell Co.

Dependable Valves Since 1846

Cincinnati 22, Ohio

POWELL VALVES

Small . . . but MIGHTY!

. . . this 3-POUND MIDGET "MEGGER"* TESTER generates *500 VOLTS* and reads up to 50 Megohms

Basically designed for maintenance men, this mighty midget is used by many engineers for testing insulation resistance of practically all types of electrical equipment. Because it is small enough to fit an overcoat pocket or tool kit, and because of its instrument accuracy and machine ruggedness it has proved itself indispensable for maintenance and trouble shooting, even where higher range "Megger" sets are available. The hand cranked generator delivers 500 volts and since no batteries or external power supply are required, it is always ready for use . . . anywhere.

**Trade Mark Reg. U.S. Pat. Off.*

If you are not already familiar with this smallest and in many ways the most remarkable member of the "Megger" family, write for Bulletin 1545-PE and Catalog 1685-PE.

Ask also for Bulletin 1735-PE describing the new U.S.-made "Megger" Testers.

JAMES G. BIDDLE CO.

1211-13 ARCH STREET • PHILADELPHIA 7, PA.

they be accurately made to the dimensions shown on the plans for the inner and outer diameters of the finished pipe, 96 in. ID, 106 in. OD. All plates had to fit together tightly so there could be no leakage of mortar while the pipe was being cast and vibrated.

A total of 4976 lineal feet of this 106 in. OD steel reinforced concrete pipe was made and laid at a total cost of $211,480, and 491 tons of reinforcing steel rods and bars were used in the welding of the cages, this alone costing $30,636.

Post-War Employment

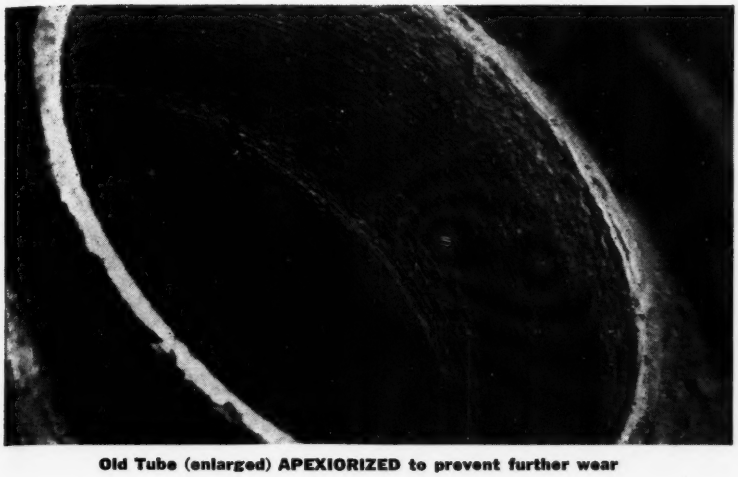
JANESVILLE, WIS., the first predominantly industrial city in the nation to complete a company-by-company estimate of its industrial and commercial employment after the war, foresees 8 per cent more jobs when war orders cease than during its present period of peak production. Figures on this survey have just been released by the Janesville Committee for Economic Development through the national office of the Committee for Economic Development in New York City.

Janesville, with a population of 23,000, employed 6208 persons in 1940 and 7421 in late 1943. After the war, its C.E.D. survey shows, its business employers have in mind 8029 specific jobs to be offered to its returning servicemen, demobilized war workers and other residents. This is more by 332 than its prospective post-war labor supply of 7707 indicated by an independent check of anticipated post-war job-seekers.

Janesville is one of 1325 communities in all parts of the country in which Committees for Economic Development are working for greatly expanded levels of peacetime production and employment after the war. A number of these have already completed their survey of industrial employers and are engaged in the second stage of the program, the survey of commerce and the service trades.

The Janesville figures have been carefully checked by a local committee of businessmen and specialists in employment studies to make sure that errors in forecasting have been eliminated as far as possible. The next step will be to survey prospective farm employment and production in the neighborhood to determine its bearing on employment prospects in the

How Much Longer Will Your Boilers Stand Up?



Old Tube (enlarged) APEXIORIZED to prevent further wear

Send for bulletin 1290 which gives the facts on a paint that gives new life to metal.

Users like these have Apexiorized their equipment. Try it on yours.

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Bethlehem Steel Company
Scovill Manufacturing Company
E. I. duPont de Nemours & Company
Chicago-Bridge & Iron Company
Pratt & Whitney Aircraft Co.
Wright Aeronautical Corporation

In these days of supercolossal war schedules, do you ever worry about the condition of your plant boilers? Do you wonder what you can do to prolong their life until the time when scarce metal becomes plentiful once more?

Many maintenance engineers have found the answers to these questions in APEXIOR . . . a special protective coating purposely made for boiler and turbine metal.

They have used APEXIOR on new equipment as well as on old equipment . . . on new equipment to insure against premature old age, on old equipment to prolong its useful service. They have, in some cases, been able to salvage discarded boilers that seemed to have outlived their usefulness by cleaning them and then coating them with APEXIOR.

APEXIOR PREVENTS CORROSION FOR 2-3 YEARS

APEXIOR is brush-applied, by hand or power coater. It seeps into the metal pores and joints and forms an impenetrable barrier against water. There is less adherent scale, so scale removal is required less often . . . and when it is necessary, the job can be done easily with a wire brush.

Painting boiler metal with APEXIOR is recommended by boiler insurance companies. And many turbine manufacturers coat shafts, rotor bodies, and, frequently, interiors of casings with APEXIOR before shipping to customers.

APEXIOR is the safe, sure answer to . . . how can boiler life be extended? It will save your boiler metal from the ravages of rust that can not be measured in dollars today. Get the facts today.

APEXIOR

A Peacetime Plus ★ ★ ★ A Wartime Must

RECOMMENDED BY ALL U. S. AND CANADIAN BOILER INSURANCE COMPANIES

The **DAMPNEY COMPANY of America**
protective coatings for
STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

THE DAMPNEY COMPANY OF AMERICA
Hyde Park 36, Mass.

Please send free Bulletin 1290 (Industrial) ☐ 1305 (Marine) ☐

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Send out a Posse

to locate your Old Darts

. . . For Used Darts Can Be Used Again!

The search goes on — in plants from coast to coast—to hunt out and find old Dart Unions. And here's why: even the Darts that have been used time and time again can give tight-joint performance. This is real economy for the plants . . . and don't forget . . . by putting used Darts back on the job, you are helping to conserve metal and hasten the day of Peace.

The explanation of how Dart's can pay extra dividends in trouble-free performance and long life lies in these facts. Dart's matched bronze seats, precision machined and ground to accurate "true-ball" surfaces make it possible for Darts to be used so many times. Dart's Nuts and Bodies, made of heavy air refined malleable iron gives Darts their ability to resist rough handling and pipe strains. So keep looking—for the reward is well worth the search. And if you need *new* Darts, your supplier will see that you get them as soon as possible.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.

city. A check will further be made on post-war federal and local public works planned for the neighborhood to complete the over-all job survey.

Emphasis in all planning by individual firms is laid on quick reconversion to peacetime production when the time comes and rapid expansion toward levels almost half again as big as in 1940.

Progress at Grand Coulee

GRAND COULEE Dam first began producing power in March, 1941, when two 10,000 kw station-service units, designed only for use on the project, were put into commercial production to forestall a threatening shortage of power for Pacific Northwest war plants. The first of the six 108,000 kw generators now in operation went into service the following October, the second in January, 1942, and the third in March, 1942.

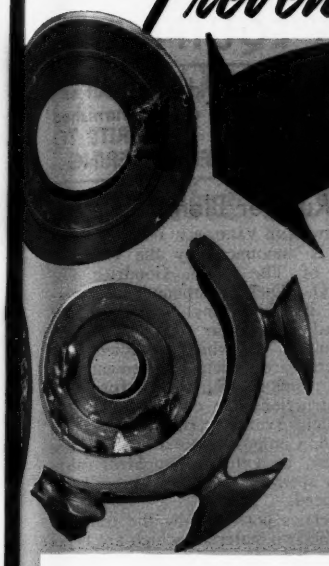
When, in the summer of 1942, another power shortage appeared imminent, two generators, rated at 75,000 kw each, were transferred to Grand Coulee from Shasta Dam of the Central Valley project (California), where the powerhouse had not been completed.

Through these units, put into production in February and May of 1943, a large block of energy was provided in eight months instead of 30 months required for the construction and installation of regular Grand Coulee units. This saving of almost two years in power production will result in an output of at least 2,000,000,000 kwhr of energy which otherwise would not have been available.

Grand Coulee's fourth main unit began operating in August, 1943, the fifth the following October, and the sixth turned for commercial purposes for the first time today. A stop-construction order issued by the War Production Board in the fall of 1942 for a time, but now with the starting of the tenth unit the capacity is 800,000 kw.

Grand Coulee Dam is the key structure of the Columbia Basin project (Washington). In the postwar period, when construction of the irrigation features of the project is scheduled to be resumed, part of the seasonal energy produced in the power plant will be used to pump water out of the Columbia river reservoir to the land to be irrigated. The project is designed to transform more than 1,000,000 acres, mostly sagebrush and desert, into productive farms.

Prevent Valve Failure *before it starts!*



VICIOUS CIRCLE of WEAR and WASTE
-- begins when you choose the Wrong Disc

When a Globe, Angle or Check Valve of the Renewable Composition Disc type is put in service with an incorrect disc, a "vicious circle" of trouble begins—premature disc wear, valve leakage, valve damage by "wire drawing" effect,—sometimes complete valve destruction.

Careful choice of discs is of first importance today because strict conservation of mechanical rubber goods is required by WPB. Also, because the "vicious circle" of trouble caused by careless selection of discs extends into plant interruptions that may delay the production of war goods.

Prevent *all* such needless valve failure before it starts . . . by using the correct valves and discs for each service . . . by proper installation . . . by frequent, thorough inspection. Repair or replace worn parts in time to prevent valves from destroying themselves. Teach new workmen to detect the first signs of valve trouble and correct it without delay.

Jenkins engineers will give you any assistance you need in developing an effective program of valve conservation.

GUIDE TO CORRECT DISC SELECTION

For the duration, Jenkins Discs must be limited to the five compounds described here. These can be recommended for a complete range of service conditions. As soon as conditions permit, we will resume manufacture of Jenkins Composition Discs in a wider variety of substances.

CLIP OUT THIS WARTIME CHART . . . For the duration, it supersedes the chart shown on page 386 of your Jenkins Catalog. Paste it on page 386 for ready reference to discs now available.

SERVICE	GLOBE, ANGLE, CHECK and Y VALVES		
	PRESSURE RANGE	MAXIMUM TEMPERATURE	DISC NUMBER
SATURATED STEAM	0# to 25# 25# to 150#	267° F. 366° F.	110-H 119-A
HOT WATER	0# to 50# 50# to 1000#	200° F. 300° F.	110-H 119-A
COLD WATER	0# to 300# 300# to 1000#	115° F. 115° F.	294 110-H
AIR and GAS	Vac. to 300# 300# to 600# Vac. to 300#	Normal Normal 200° F.	294 110-H 294
OIL	0# to 150# 0# to 250#	125° F. 250° F.	936-A 119-A
GASOLINE	0# to 300#	Normal	936-A
OTHER SERVICES	Specific disc recommendations will be made on receipt of detailed service information.		

No. 110-H. Semi-hard Disc for:

SATURATED STEAM at pressures up to 25 pounds and maximum temperature of 267° F.

HOT WATER at pressures up to 300 pounds and maximum temperature of 250° F.

COLD WATER at pressures up to 1000 pounds and maximum temperature of 115° F.

AIR AND GAS at pressures up to 600 pounds and normal temperature.

Maintains tight seal within recommended pressure and temperature range. Satisfactory for air and gas service when oil is not prevalent in the line.

No. 119-A. Hard Disc for:

SATURATED STEAM at pressures up to 150 pounds and maximum temperature of 366° F.

HOT WATER at pressures up to 1000 pounds and maximum temperature of 300° F.

OIL at pressures up to 250 pounds and maximum temperature of 250° F.

Hard but sufficiently resilient to maintain tight seal within recommended pressure and temperature range. Very tough and dense in structure, with high flexural and impact strength. Will not crack, either while being fitted into holder or in service. Will not swell, creep, flake, fray, chip, distort, or delaminate in saturated steam or hot water; has very good resistance to oil. Satisfactory for acids of low concentration. Sufficiently alkali-resistant to meet practically all boiler feed-water conditions.

No. 294. Medium-soft, Resilient Disc for:

HOT WATER at pressures up to 50 pounds and maximum temperature of 200° F.

COLD WATER at pressures up to 600 pounds and maximum temperature of 115° F.

This disc is very tough, dense and enduring. It seals tightly the instant it is introduced into service and maintains tightness for long period within recommended pressure and temperature range.

No. 936-A. Medium-soft, Resilient, Synthetic Disc for:

OIL at pressures up to 100 pounds and maximum temperature of 125° F.

GASOLINE at pressures up to 75 pounds p.s.i. and normal temperature.

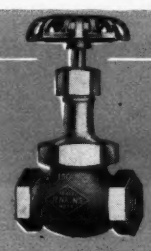
Has high resistance to lubricating and fuel oils, as well as benzol, gasoline and gas (including illuminating). Gives instantaneous tightness within recommended pressure and temperature range. Can also be used on air and gas service at low pressures and maximum temperature of 125° F., particularly when oil is present in the line.

No. 946-A. Synthetic disc similar in composition to No. 936-A, but slightly softer. Recommended for use on wide seating surfaces under same conditions as No. 936-A.

TRADE JENKINS MARK

Jenkins Bros

Jenkins Bros., 80 White St., New York, 13, N. Y.; Bridgeport, Atlanta, Boston, Philadelphia, Chicago, Jenkins Bros., Ltd., Montreal; London, England.



JENKINS VALVES

SINCE 1864

For every industrial, engineering, marine and power plant service . . . in Bronze, Iron, Cast Steel and Corrosion-Resisting Alloys . . . 125 to 600 lbs. pressure.

SAVE COAL

—with FYR-FEEDER Multiple SPREADER Stokers

FYR-FEEDER stoker firing not only saves coal, but also permits you to burn any kind of wet or dry bituminous coal you have available locally—screenings or sweepings, any melting point of ash, free-burning or coking coals.

Burns Coal like Oil: FYR-FEEDER burns fines in suspension, burns larger pieces on grate. Coal is spread over entire fuel bed. Thin fuel bed—no clinkers. Fires can be cleaned in two minutes! Suitable for large or small boilers. Very little maintenance cost. In many cases FYR-FEEDER stokers have made it unnecessary to add another boiler to handle increased loads.

FYR-FEEDER is our own original design. FYR-FEEDER is not a copy of any other stoker but our own invention developed by us, and our engineering experience with spreader stoker design, installation and operation began in the last century.

WET COAL IS NO HANDICAP

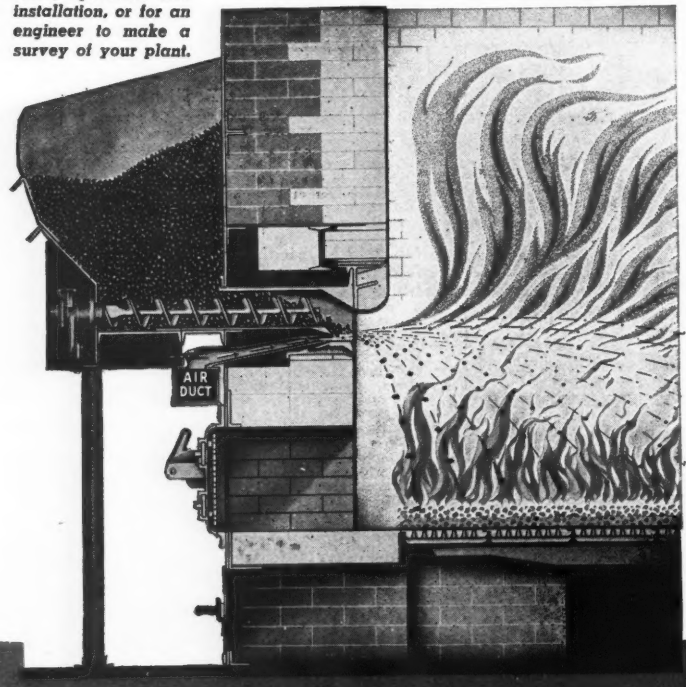
Coal men like the FYR-FEEDER because FYR-FEEDER users do not insist upon the delivery of "DRY" coal since FYR-FEEDER handles "WET" coal satisfactorily. Regardless of "rain and snow watered" coal, FYR-FEEDER stokers produce plenty of steam from "WET" coal. FYR-FEEDER was designed to use "WET" coal or dry coal.

AMERICAN COAL BURNER COMPANY

—Engineers—

WRITE FOR CATALOG describing features, operation and installation, or for an engineer to make a survey of your plant.

22-18 E. Erie St. Chicago 11, Ill.



NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. WRITE TO POWER PLANT ENGINEERING

New Rubber Blends

A NEW AND VALUABLE series of elastomers, is announced by the Chemical division of The B. F. Goodrich Co., Akron, O. These compounds are mixtures of its Geon vinyl resins, recently announced, and Hycar oil resistant synthetic rubber, in which butadiene and acrylonitrile are principal ingredients.

Geon resins as such will be furnished, with instructions for compounding with oil resistant synthetic rubber when this is desired. Compositions made from these blends can be extruded, molded, calendered, or spread. A mirror-like finish can be produced.

Properties possessed by the combination of the two materials which are better than when the oil resistant rubber is used alone are reported to be extreme resistance to the effects of sunlight and ozone, increased resistance to benzene and similar aromatic solvents, both in swelling and cracking, low temperature flexibility combined with excellent heat resistance, improved flexing life, tear resistance, resilience and oven aging.

Bushing Cement

DOLPH'S No. 16-A Bushing Cement was originally designed to cement transformer leads into porcelain bushings. Because of its unusual properties, it is well adapted for use as a permanent sealer for cable joints, boxes, instruments and for other similar applications.

This Bushing Cement is a black compound having excellent adhesion to metal and porcelain and unlike similar conventional compounds, this product has a very low coefficient of contraction. It becomes extremely hard and will stand the strain of rapid temperature changes. Because it is both oil and waterproof, it will prevent oil leakage and water seepage. It is homogeneous and retains its uniformity during melting, thereby eliminating the possibility of caking during the melting process. Then too, this material will not foam when it is heated. The melting point is 265 F and it has a pouring temperature of 400 F. This cement is manufactured by John C. Dolph Co., 168 Emmett St., Newark 5, N. J.

Improvements Announced in General Electric's D-C Arc Welders

IMPROVEMENTS in its line of direct-current, single-operator arc welders, Type WD-30 series, have been announced by the Electric Welding Division of the General Electric Co. In addition to retaining all the desirable features of this well known line, these welders are now equipped with two new control dials and a redesigned driving motor. The control dials permit the welding current to be preset without the aid of a volt-ammeter, and the driving motor is designed to give exceptional resistance to the weather when the welding machine is operated outdoors.

Large in size and conveniently located, one of the control dials is calibrated in terms of electrode size. The operator sim-

One purpose...

the IMPROVEMENT of Metals

40-Page Reference Data Book on Forgings Available on Request

by Forging

For the *unpredictable emergency,* use forgings. This new Reference Data Book contains technical information on how to utilize forgings to *insure dependable performance* under a wide variety of operating conditions, and obtain a greater factor of safety, in all kinds of equipment and operating mechanisms for war, as well as peacetime, use. All phases from Forging Design to Forging Metallurgy are treated in this book. The factual data it contains on THE IMPROVEMENT OF METALS BY FORGING, provides dependable guidance for design engineers, metallurgists, production and management executives who must exercise good judgment in the selection and use of materials. Write for a copy of this book on your business letterhead.

DROP

THE STEEL IMPROVEMENT & FORGE CO.

FORGINGS 964 East 64th Street CLEVELAND, OHIO

N°1 INSULATING CEMENT

. . . Gets Along Fine with Metal Surfaces

A special rust-inhibitor used in B-H No. 1 Cement prevents corrosion. Whether applied on a hot surface where it dries immediately or is allowed to air-dry over a long period of time, it will not attack metal surfaces. This means a permanent bond—an installation that stays put.

No. 1 Cement is sufficiently elastic to absorb ordinary expansion and contraction without peeling or cracking. Made of high-temperature-resisting, nodulated B-H *black* rockwool, long fibred asbestos, and colloidal clay, it does not form a homogeneous mass. The rockwool retains its physical characteristics and the countless number of dead-air cells provide maximum insulating efficiency up to 1800° F. Send for sample and complete data. *Baldwin-Hill Co., 577 Klagg Ave., Trenton 2, New Jersey. Plants in Trenton, New Jersey; Kalamazoo, Michigan; and Huntington, Indiana.*

Baldwin-Hill

COMPANY

HEAT & COLD INSULATIONS

ply sets this dial to correspond to the size of the electrode being used. The other dial indicates the range of welding current available for use under these conditions. The operator presets the welding current merely by rotating a pointer to whatever amperage he wishes to use. Clear, easily read calibrations facilitate quick, accurate operation of both dials.

Jaeger Speed Indicator

JAMES G. BIDDLE CO., 1211-13 Arch Street, Philadelphia 7, Pa., announce the production for the first time in this country of the Jaeger Speed Indicator. This is a "vest pocket" speed-measuring device which adds up the number of revolutions over a period of six seconds, and shows the revolutions per minute without any calculations. The instrument is not read while operating—it is just let run until it stops automatically, and is read at leisure. It shows the average speed during the time interval of testing, and is quite more than commercially accurate.

The speed indicator differs from the conventional centrifugal type tachometer in that it does not show the instantaneous speed or speed variations, but it has the advantage that the hands stop automatically at points which indicate the meas-

ured speed, and one has as long a time to read the instrument as one may wish. It is not much larger—or heavier—than a good sized watch. Both rpm and feet per minute speeds can be measured.

There are two ratings of the instrument, one for all speeds up to 2000 rpm and the other for speeds up to 10,000 rpm. In the low speed instrument, one revolution of the hand on the large dial indicates 100 rpm in equal divisions of 1.0 rpm readable to 0.5 rpm and one revolution of the small hand indicates 1000 rpm.

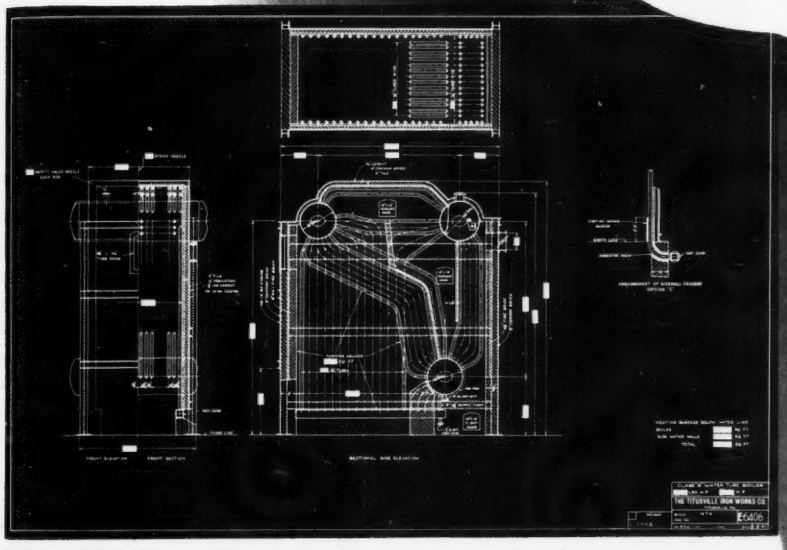
Similarly, in the higher-speed instrument one revolution of the hand on the large dial represents from 0 to 1000 rpm in equal divisions of 10 rpm, readable to 5.0 rpm, and the small dial indicates to 10,000 rpm.

Fluorescent Units

A NEW LINE of individual fluorescent units and continuous wireway has been developed and recently announced by the HOLDENline Company, 1960 East 57th Street, Cleveland 3, Ohio, and is being marketed under the name Chan'l-Run. These units made in standard steel sections of special design, and, equipped with Kemilume processed

TITUSVILLE WATER TUBE BOILERS

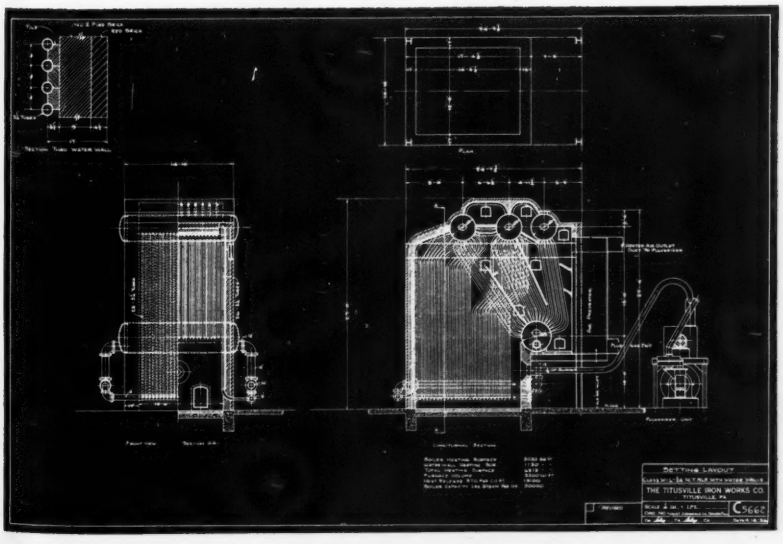
for
DEPENDABLE STEAM GENERATION



TITUSVILLE Water Tube Boilers—serve America's Armed Forces all over the world with the same efficient, safe, dependable performance they have provided leading industrial and institutional applications for more than *fifty years.*

When you are confronted with a boiler problem, for any service, new or replacement,—TITUSVILLE engineers will gladly cooperate—anytime, anywhere.

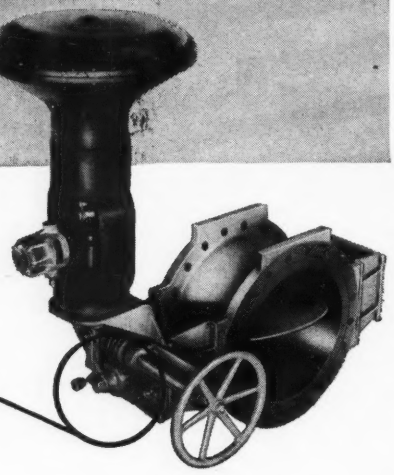
Descriptive Bulletins on request



STRUTHERS WELLS CORPORATION
TITUSVILLE BOILER DIVISION
TITUSVILLE, PENNA.
Plants at TITUSVILLE, PENNA. and WARREN, PENNA.

Forestall Valve Inaction

with Declutching Unit and Hand Wheel



No. 587

125-pound valve power operated by diaphragm motor. Declutching unit and hand wheel for use in emergencies.

While the majority of R-S Butterfly Valves are manually operated, they are also adapted to power operation. In such power installations, the inclusion of the R-S declutching unit (patent pending) and hand wheel has *four advantages*.

In the first place, if it is desirable to install a manually controlled valve and, at a later date, it becomes advisable to obtain some type of prime mover for automatic control, the prime mover can then be installed in the field.

If the delivery date of the prime mover can not be made to coincide with the delivery of the valve, the valve can be installed and operated at once by hand.

A power failure will cause a power operated valve to be inoperative. Such is not the case, however, when a declutching unit and hand wheel are provided.

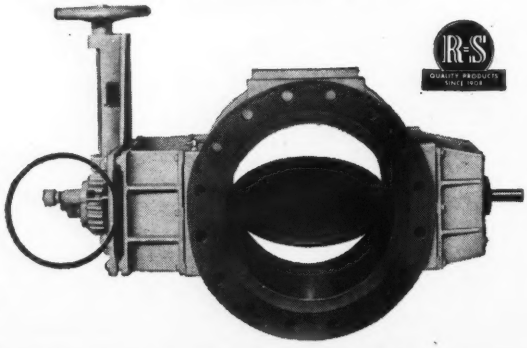
Likewise, the removal of the prime mover for maintenance, does not result in valve inaction since the valve can be operated manually at any time simply by removing the pull pin from the link which connects the diaphragm reach rod or piston to the link.

Investigate the many advantages of R-S Butterfly Valves **(15 to 900 psi)** and especially the merits of the R-S declutching unit and hand wheel.

VALVE DIVISION

R-S PRODUCTS CORPORATION

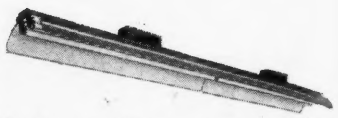
4535 Germantown Ave. • Philadelphia 44, Pa.



No. 588

125-pound valve with two outboard bearings and hand wheel control with declutching unit. Note absence of power operator which will be installed after the valve is placed in operation.

R-S Streamlined BUTTERFLY VALVES



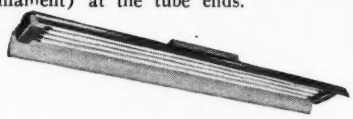
Ligniform reflectors, are so rigidly formed, that while they conform to WPB steel limitations, only one hanger strap is required for hanging each section. An entire row may be assembled complete with reflectors ready to be mounted and quickly connected to line wires, affording marked economies in time and labor.

Simply designed connecting straps join one section with another, but the basic element in the design is the easily handled sturdy steel channel from which HOLDENline Chan'l-Run derives its name.

For two 40-w lamps, sections come in two lengths, 48 and 96 in. Similar simplification is indicated in the channels for two 100-w lamps which are furnished in units of 60 and 120 in. respectively.

Cold Cathode Fluorescent Unit

KOLD-VOLT, a new cold cathode fluorescent industrial lighting unit is announced by the Mitchell Manufacturing Co., 2525 N. Clybourn Ave., Chicago 14, Ill. In appearance and general lighting qualities, the cold cathode lamps used in this new unit are similar to the conventional "F" type fluorescent lamps, except that they are 7 ft 9 in. long, 1 in. in diam, and employ a different type of cathode (or filament) at the tube ends.



Advantages offered are reported to be: (1) Starters are eliminated. (2) Starting is instantaneous. There is no flickering. (3) Useful lamp life is four times that of a conventional type "F" fluorescent lamp. Average lamp life expectancy is 10,000 hr. (4) Operates at lower room temperatures. (5) Not sensitive to line voltage variation. Operates on regular 110-125 v a-c, will start instantly and light the tubes on line voltage as low as 100 v without flicker. (6) Reduces maintenance time and cost. (7) The 8 ft length means fewer fixtures to install. (8) Surface brightness (glare) is substantially reduced.

One Kold-Volt fixture uses 4 Colovolt cold cathode low voltage fluorescent tubes, delivers a total of 8800 lumens of light. It may be surface or suspension mounted, individually or in continuous rows. Mounting brackets and knockouts are provided. Has a sturdily constructed heavy gage steel wireway channel, with two Duo Ballasts on top exposed for greater air circulation, cooler operation and longer life.

The reflector is non-metal Lumenite, finished in chip-proof baked white enamel inside, and attractive gray outside. Specially designed sockets make it easy to install the lamps in a few seconds. A special disconnect switch automatically cuts off current so that lamp replacement is always made with the power disconnected.

The Mitchell Kold-Volt Model No. 2081 operates from ordinary 110-125 v, 60 cycle a-c circuits at a power factor of 99 per cent. Stroboscopic corrected.

PREHEAT *can Help YOU...*

1. to Improve Combustion OF LOW-GRADE FUELS
2. to Raise the Level OF HEAT RECOVERY
3. to Save Materials IN PLANT DESIGN

Recent applications of Ljungstrom Air Preheaters are doing all three!

AT A MIDWESTERN INDUSTRIAL PLANT, coal with a moisture content exceeding 15% is being successfully pulverized and burned with high efficiency. Ljungstrom Air Preheaters furnish air heated to 500 F to make it possible.

A NEW ENGLAND UTILITY has installed a highly advanced steam generating station, using forced steam circulation, and incorporating two-stage superheater, reheater and economizer. But the final step in high-efficiency heat recovery is left to two Ljungstrom Air Preheaters, which bring stack gases down to less than 300 F.

AN OIL-REFINERY CRACKING FURNACE, designed for a high level of heat economy, saves alloy steel in the convection tube banks by use of a Ljungstrom heater. Gases leaving the furnace at 1300 F are cooled to 580 F, heating combustion air to 1062 F. A more efficient, compact furnace results.

PREHEATER EXPERIENCE which has made these gains possible is available to you or your consultants on any project requiring efficient gas-to-air heat transfer from 300 to 1500 F. Included are industrial applications for synthetic rubber, ore roasting, etc., as well as steam generation.

* * *

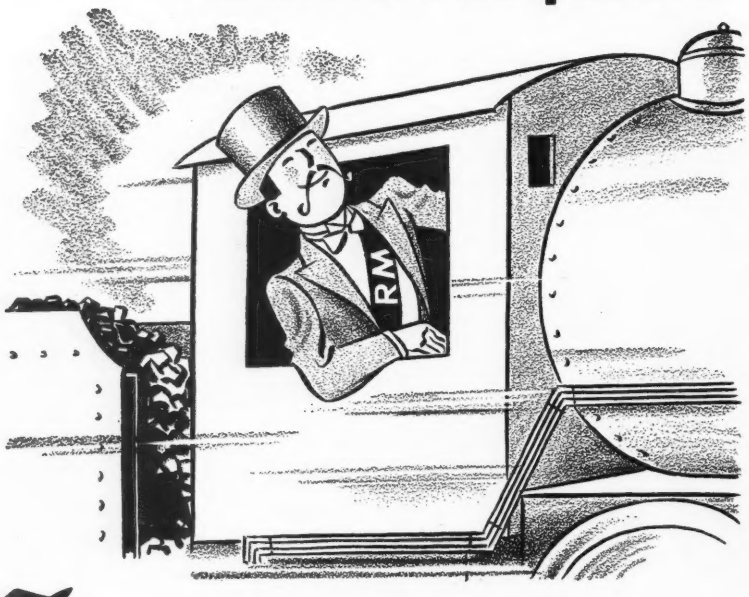
Write today for this booklet. It describes the principle and construction details of Ljungstrom Air Preheaters and the fuel-saving economies it makes possible.

THE AIR PREHEATER CORPORATION

OFFICES: 60 EAST 42nd STREET, NEW YORK 17, N. Y.

PLANT: WELLSVILLE, N. Y.

R/M PACKINGS
throttle the joints



Today's locomotives are typical users of R/M packings. Steam connections, valves, pistons, air-brakes are some of the spots where R/M serves to speed supplies—when extra wearability means many more miles of service.

Railroads and other vital industries must have first call on R/M production in time of war, but we will continue to try to serve your requirements through your regular mill-supply house.

ARMY E NAVY

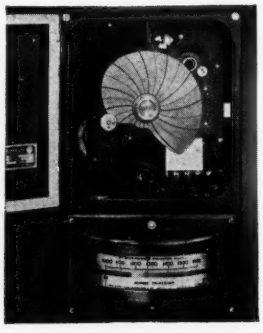
INDUSTRIAL SALES DIVISION
RAYBESTOS-MANHATTAN, INC.
MANHEIM, PA.
BRIDGEPORT, CONN. NORTH CHARLESTON, S. C. PASSAIC, N. J.
Makers of Packings for Every Industrial Use

Temperature Controllers

WHEELCO INSTRUMENTS Co., Harrison and Peoria Sts., Chicago 7, Ill., has announced the development of a line of instruments to enforce any desired heating or cooling program.

The instruments, named Chronotrols, are built around the company's established line of pyrometers, potentiometers, thermometers and resistance thermometers, all of which employ an electronic principle of effecting temperature control. They provide completely automatic temperature regulations, regardless of the changes in temperature setting lever of the control instrument.

Chronotrols are offered in 25 models, including ten for proportioning control and others for two-position on-off and three-position on-intermediate-off control for high and low-temperature applications. Thermometer models are available in recording as well as indicating types.



Absence of mechanical linkage between the measuring and control sections of Chronotrols makes possible instant response of the instrument's control unit to changes in temperature noted by its sensing unit. The frequency of oscillating current flowing between pickup coils, mounted on the temperature control setting index, is changed when a control flag mounted on the pointer or pen arm is moved between the coils by a temperature rise, or is moved from between the coils by a temperature drop. This frequency change in the control circuit governs the output current of a vacuum tube, acting to open relay contacts which, in turn, operate fuel valves or switches.

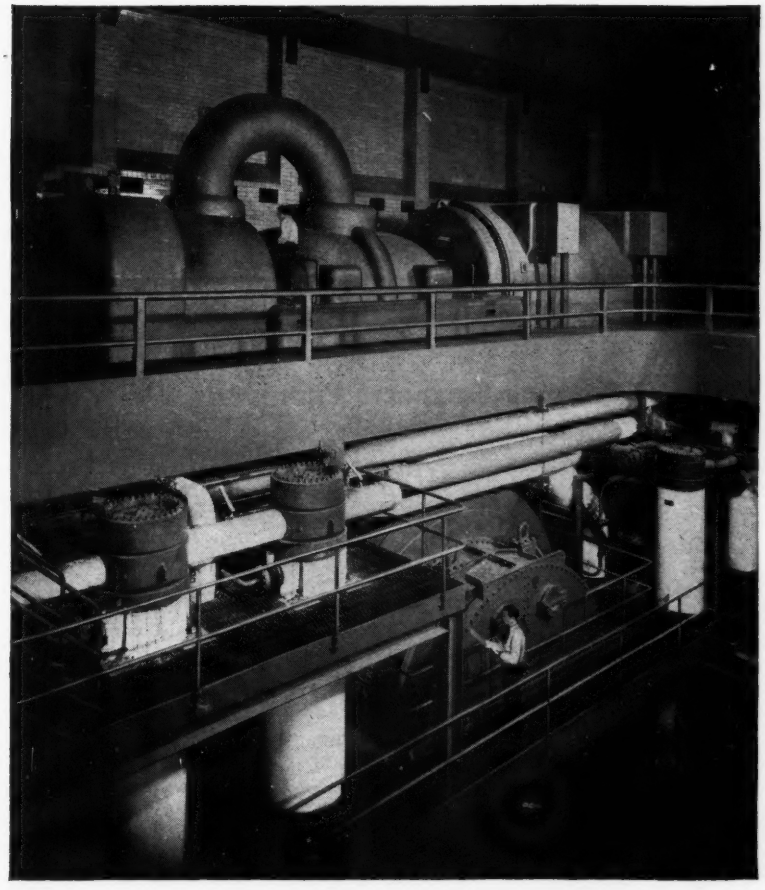
Two-Dial Process Timer

GENERAL ELECTRIC Co.'s Switchgear Division has announced a new two-dial rotary-type process timer which regulates the flow of products in catalytic processes such as the production of hi-octane gasoline, butadiene for synthetic rubber, and toluene for explosives.

During the manufacture of these products, hundreds of accurately timed, sequential operations must be performed. Some of these operations involve the opening and closing of electrically operated valves, dampers, and other devices in a definitely timed cycle. A complete cycle of operations may require from twenty minutes to three hours, or more; from 18 to 75 devices may be controlled; and from 100 to 900 contact points or timing intervals may be needed.

These requirements are met by the new process timer in which each of the two dials has two concentric rings or rows of 224 contact points each, a total of 896. Each dial has a rotating contact arm. The arms are geared to a single shaft and can be driven through a clutch

ALCO High-Pressure Feedwater Heaters Feature in Ultra-Modern Plant



THIS strikingly modern equipment is a recent installation in a large eastern public utility power station.

Consistent with the advanced practice evident in the installation is inclusion of five *ALCO Feedwater Heaters.* Three are high-pressure units, two low-pressure.

Two of the high-pressure ALCO heaters can be seen at the left in the above picture. Operating at 1500 lbs. pressure, these heaters heat the water to 430 degrees final temperature.

ALCO feedwater heater engineering has been conspicuously successful in high-pressure service. Several ALCO installations are operating successfully at 2200 lbs. pressure.

It should be noted that each of the high-pressure ALCO units in the installation shown is equipped with *ALCO Vertical Condensate Drain Cooler.* ALCO's development of a thoroughly reliable drain cooler for vertical operation is only one example of ALCO's contribution to better feedwater heater design.

All of these five ALCO feedwater heaters have *ALCO Clamp Ring Joints*—another ALCO specialty which is greatly promoting maximum continuity of service.

Continued selection of ALCO feedwater heaters is the best evidence of their superiority. ALCO Bulletins covering this equipment will be promptly sent on request. ALCO feedwater heater and heat exchanger engineering specialists are available for consultation.

AMERICAN LOCOMOTIVE COMPANY

ALCO PRODUCTS DIVISION

30 Church Street, New York 8, N.Y., Dunkirk, N.Y.

ALCO PRODUCTS

HEAT EXCHANGERS • PRESSURE VESSELS • PREFABRICATED PIPING

HENSZEY
BOILER FEED REGULATORS

offer

CONTINUOUS, TROUBLE-FREE BOILER WATER LEVEL CONTROL

For peak efficiency boiler water must be held to the proper levels at all times. Henszey Regulators have proved to be ideally suited for practically all boiler conditions. Here's why . . .

- **HOLDS WATER LEVELS TO CLOSE LIMITS**
  The Henszey Regulator is extremely sensitive—there is less lag.
- **METALLIC EXPANSION**
  The Henszey Regulator works on the positive metallic expansion principle—no small tubes to spring leaks.
- **NO STRUCTURAL SUPPORTS**
  The Henszey Regulator goes right in the line—needs no supporting members.
- **POSITIVE VALVE MECHANISM**
  The Henszey Regulator uses a special valve made expressly for this instrument by a prominent valve maker.
- **LESS SPACE**
  The Henszey Regulator can be installed in cramped places using up very little space. Easy to install as a simple gate or globe valve.

Plan now for continuous, automatic boiler water level control . . . investigate Henszey Boiler Feed Regulators.

Send for Bulletin

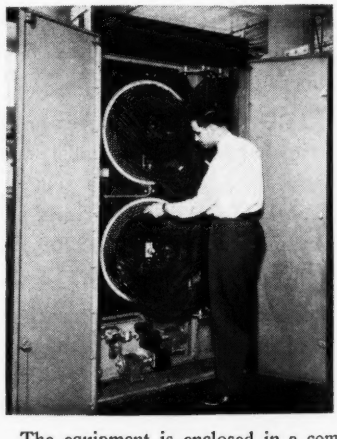
HENSZEY CO. Dept. C4, Watertown, Wis.

HENSZEY
BOILER FEED REGULATORS

Continuous Blowdown • **Distillation Systems** • **Heat Exchangers**
Feed Water Meters • **Flow Indicators** • **Proportioning Valves**

by a synchronous motor and adjustable gear train, or they can be operated independently from separate motors. A spare motor and a handwheel for operating the unit manually are also available. The circuit to the segments is made and broken through an auxiliary switch, not at the segments, and the unit will easily handle control circuits of 10 amp, 125v.

This timer is essentially a large motor driven selector switch and operates at a speed which may be selected to suit the process. It is arranged to complete the circuit to the controlled device or an alarm circuit as a moving brush selects each point. Flexible jumpers are provided for connecting between the segments and a terminal board. The jumpers are plugged to the segments which will provide the desired operating cycle, and all incoming controls leads are brought to the terminal board.



The equipment is enclosed in a compact steel housing, with a window for viewing the timer segments and operating arm, and will line up with other control panels and instrument boards which may be required. The timer is designed to provide maximum flexibility of operation with a minimum of adjustments and maintenance.

Sluice Gate With Curved Entrance

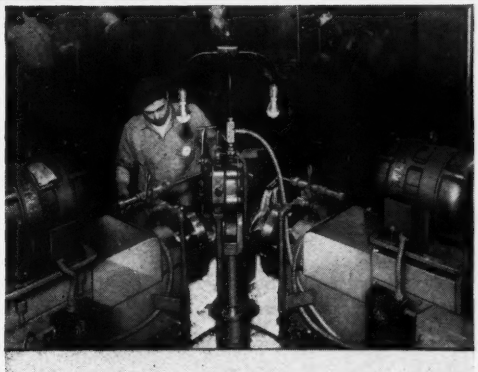
THE WATER CONTROLLING APPARATUS DIV. of the Rodney Hunt Machine Co., Orange, Mass. has incorporated an important innovation in sluice gate design as shown in this photograph of one of several such gates recently designed and built for an installation in Mexico.

Exact INCLUDED ANGLE

ANOTHER REASON WHY MIDWEST WELDING ELBOWS Are So Often Preferred

There are several important reasons why, among qualified pipe welders, Midwest Welding Elbows have earned a reputation for exceptional dimensional accuracy and uniformity. One reason is because the included angle of 90° or 45° between the machine-beveled ends is always exact . . . both ends are simultaneously machined as shown at the right. The elbow's final sizing in compression makes it possible for the fixture to clamp it in accurate position—so the center-to-end dimension is always the same.

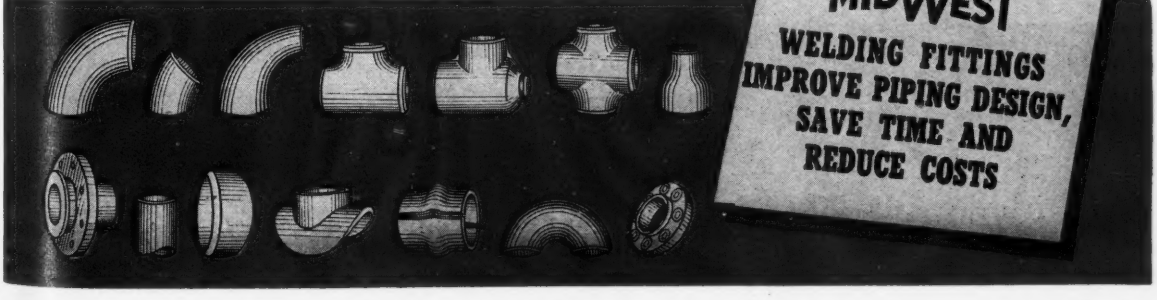
For data on all the advantages of Midwest Elbows . . . and the other Midwest Welding Fittings . . . ask for Bulletin WF-41.



Shown here is one of the machines especially built by Midwest for simultaneously machine-beveling both ends of Midwest Welding Elbows and holding the included angle within extremely close limits. Special fixtures and special tools were also developed for this work. Similar machines with three heads are used for finishing Midwest Tees.

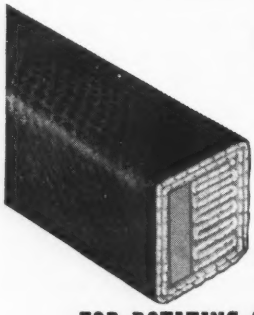
MIDWEST PIPING & SUPPLY CO., Inc.

Main Office: 1450 South Second St., St. Louis, Mo.
Plants: St. Louis, Passaic (N.J.) and Los Angeles
Sales Offices: Chicago—645 Marquette Bldg. • Houston—229 Shell Bldg.
Los Angeles—520 Anderson Street • Tulsa—533 Mayo Bldg.
New York—(Eastern Division) 30 Church Street



MIDWEST
WELDING FITTINGS IMPROVE PIPING DESIGN, SAVE TIME AND REDUCE COSTS

BELMONT PACKINGS



FOR RECIPROCATING STEAM RODS

Belmont 30

For reciprocating steam rods where boiler temperature is in excess of 100 lbs. (340 degrees F.)

FOR ROTATING SHAFTS

Belmont 754 P

For all types of centrifugal and rotary conditions, as well as oscillating rods.

FOR STEAM

Today, the war demands uninterrupted service of power plant equipment. Engines and pumps must be kept operating at maximum capacity—there is no time for frequent packing replacements.

Leaking valves . . . pistons . . . rods and plungers cause power losses which cut serious inroads into production.

Check now the packing in your stuffing boxes—at points of service—at prime movers—put the right packing on each job to avoid unnecessary delays through equipment failures.

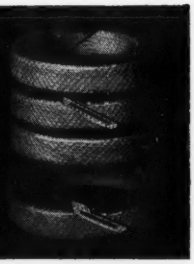
Above we illustrate two standard Belmont Packings for steam services. Belmont High Pressure Packing No. 30 is indicated wherever a packing is needed for high pressure steam rods, expansion joints, air and gas services.

For centrifugal and rotary shafts working against steam, water, oil and weak acids Belmont 754 P can be considered a standard packing.

Belmont distributors are located in every large industrial center, or write on your company letterhead for a copy of the Belmont Packings Catalog and see the complete Belmont Line in detail.

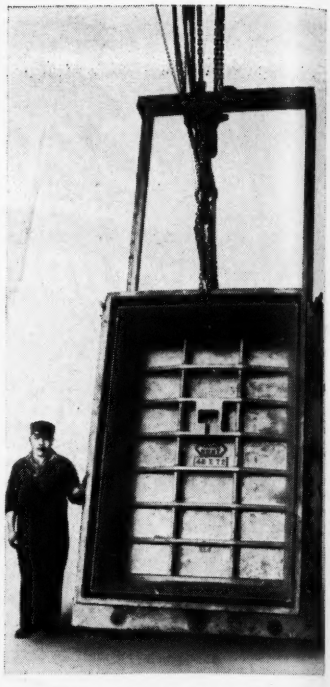
THERE'S A BELMONT PACKING FOR EVERY SERVICE

Steam, Water, Oil, Gas, Air, Acids, Alkalies, Ammonia. Forms include: Rings, Spirals, Coils, Reels, Spools, Sheets, Gaskets.



THE BELMONT PACKING & RUBBER COMPANY

BUTLER & SEPVIVA STREETS • PHILADELPHIA 37, PA.

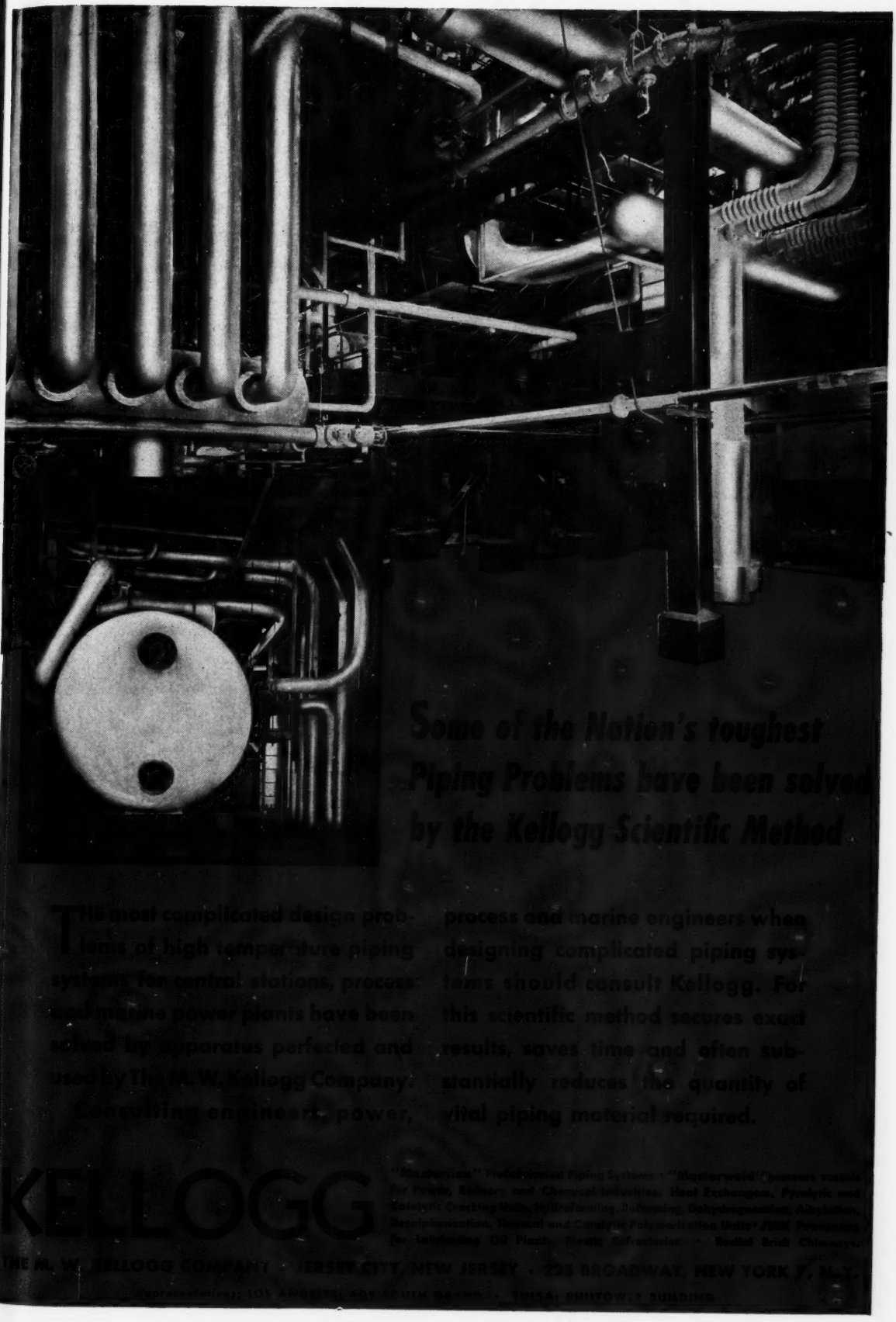


The huge casting which forms the entrance to this 48 in. by 72 in. sluice gate has been curved to cut down losses as the water flows through the gate opening. The degree of curve was worked out after extensive tests which proved that this simple modification of conventional gate design would pay high dividends in water control efficiency.

Constant Level Lubricator

THE IMPROVED Constant Level Lubricator, Type J, developed by Oil-Rite Corp., 3499 So. 13th St., Milwaukee 7, Wis., offers an automatically controlled visible oiling method for most types of bearings being especially adapted for use on electric motors, pillow blocks, textile and paper-making machinery, pumps, air conditioning equipment, ventilating fans, gear boxes, wherever bearings and other machinery parts must be provided with an ample supply of lubrication.

In operation, when the reservoir is filled with oil, only enough oil will be released from the reservoir to bring the level in bearing oilwell to the oil level line marked on the base of the lubricator.



Some of the Nation's toughest Piping Problems have been solved by the Kellogg Scientific Method

THIS most complicated design problems of high temperature piping systems for central stations, process and marine power plants have been solved by apparatus perfected and used by The M. W. Kellogg Company.

Consulting engineers, power, process and marine engineers when designing complicated piping systems should consult Kellogg. For this scientific method secures exact results, saves time and often substantially reduces the quantity of vital piping material required.

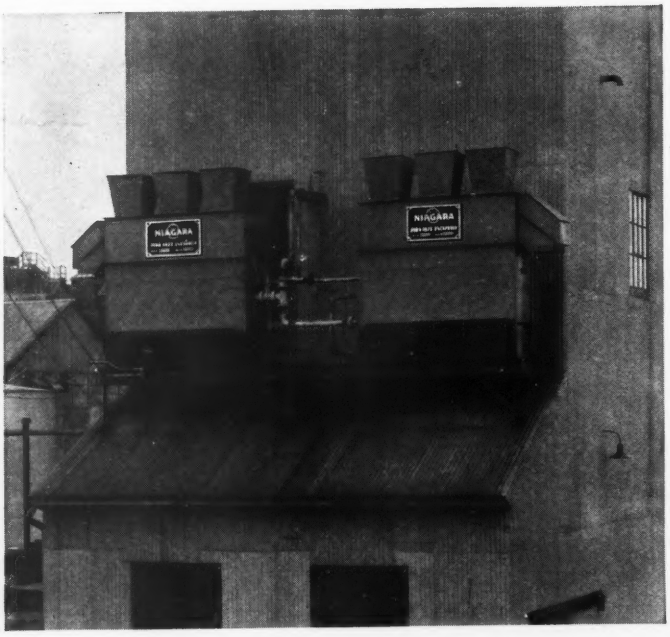
KELLOGG

"Kellogg" Prefabricated Piping Systems • "Monarweld" pressure vessels for Power, Refinery and Chemical Industries • Heat Exchangers, Pyrolytic and Catalytic Cracking Units, Hydroforming, Refining, Dehydrogenation, Alkylation, Desulphurization, Thermal and Catalytic Polymerization Units • "UOP" Processes for Lubricating Oil Plants, Stills, Accumulators • Radial Brick Chimneys

THE M. W. KELLOGG COMPANY • JERSEY CITY, NEW JERSEY • 225 BROADWAY, NEW YORK 7, N. Y.

Representatives: LOS ANGELES, 605 SOUTH GRAND • TULSA, PHILTOWER BUILDING

For Lower Costs and Dependable Results in LIQUID COOLING



● Wherever there is a need for the use of cooling water or the cooling of any liquid to exact temperatures, the NIAGARA *AERO* HEAT EXCHANGER provides a more accurate control and lower costs for cooling. Refrigeration is not needed.

These results are advantageous in all types of water-jacketed and water-cooled equipment; for example, they have solved for many the troubles coming from excess water and oil in air compressor lines. Other uses include the cooling of diesel engines and hydraulic equipment; also chemicals and intermediates requiring cooling or controlling temperatures in chemical processes.

In addition, wherever used, it saves practically all the expense of cooling water and the cost of piping, pumping and extra equipment. Users have cut such costs as much as 95%.

Write for complete information

NIAGARA BLOWER COMPANY

"25 Years of Service in Air Engineering"

NEW YORK Address: Dept. PP-44
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New York-17, N. Y.

Field Engineering Offices in Principal Cities

NIAGARA

INDUSTRIAL COOLING • HEATING • DRYING HUMIDIFYING • AIR ENGINEERING EQUIPMENT

When the bearing oil level falls, air is admitted into the reservoir through a vent, thus automatically releasing just enough oil to restore the original level.

Construction of the Oil-Rite Constant Level Lubricator consists of three parts: the base, dome, and reservoir. In the base are a bottom and side outlet for connection to the bearings, either or both of which may be used. In the center is a large air intake opening which can be connected to a filter if necessary or to a breather tube on the bearing. The oil level is clearly marked on the outside.

The dome maintains the oil level at its lower edge and acts as a stopper or valve to prevent spilling of oil in filling or removing reservoir.

The reservoir provides visible means of checking oil supply. It is sealed to a collar with a new type of plastic cement providing a 50 per cent stronger bond than on earlier models and is not effected by oil, water, heat, or acid.

The operating principle provides large and separate size passages for air and oil, hence the flow of lubricant is not restricted in any way.

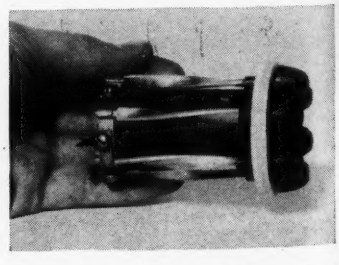
These lubricators are available in four standard sizes with capacities of 2, 4, 8, and 16 ounces.

New Iron Cement

FIX-IRON, said to be unusually effective for repairing broken, cracked, or defective metal castings, piping, and the like, making joints, seams, and loose parts secure; and stopping leaks in boilers, furnaces, fire-pots, and other metal equipment, is a new product developed by So-Lo Works, of Loveland, Ohio. Fix-Iron is in powder form, and mixed with water as used. No heat is required. It is quickly and easily applied with a putty knife or similar tool and may be hammered into cracked or broken parts. It rapidly hardens like iron. After metallizing, it possesses the same expansion and contraction properties as iron itself, thus assuring a permanently tight joint regardless of temperature changes. This cement can be used on iron, steel, brass, and other metals, also on wood, with equal success.

Multiple Potentiometer

A MULTIPLE CONTROL has been developed by the American Pattern & Mfg. Co., Fisher Building, Detroit, Mich. In this new device, operable either as a rheostat or as a multiple potentiometer, a number of contactors roll upon a single resistance coil. Each of the contactors is in the form of a twisted bar and is insulated from each other contactor to



engage successive convolutions of the coil to permit accurate control of the current supplied without influencing the current delivered by any of the other contactors.

The photograph shows a unit having six contactors but it can readily be made

DOWELL INDUSTRIAL CHEMICAL CLEANING SERVICE

CHEMICAL CLEANING IS QUICK — SAFE — EFFECTIVE

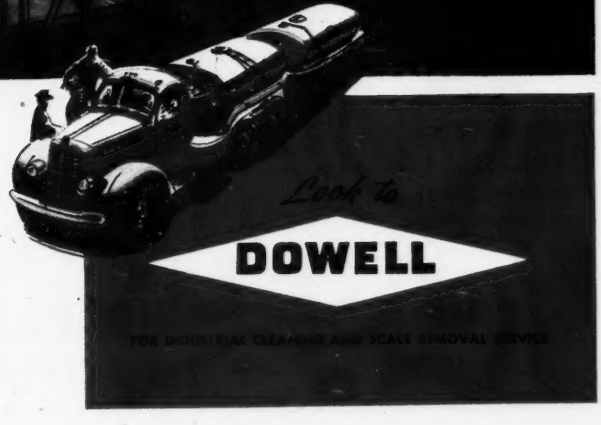
The Dowell chemical method of dissolving and disintegrating water-deposited scales and sludges from all types of heat exchange equipment is the modern answer to a troublesome industrial problem.

This chemical cleaning service reduces down-time to an absolute minimum. The solvents penetrate wherever steam and water flow, making it unnecessary to dismantle the equipment.

The inhibited Dowell solvents used for this work have discriminating appetites — they attack and dissolve most types of scales and sludges but have no harmful effect on the equipment.

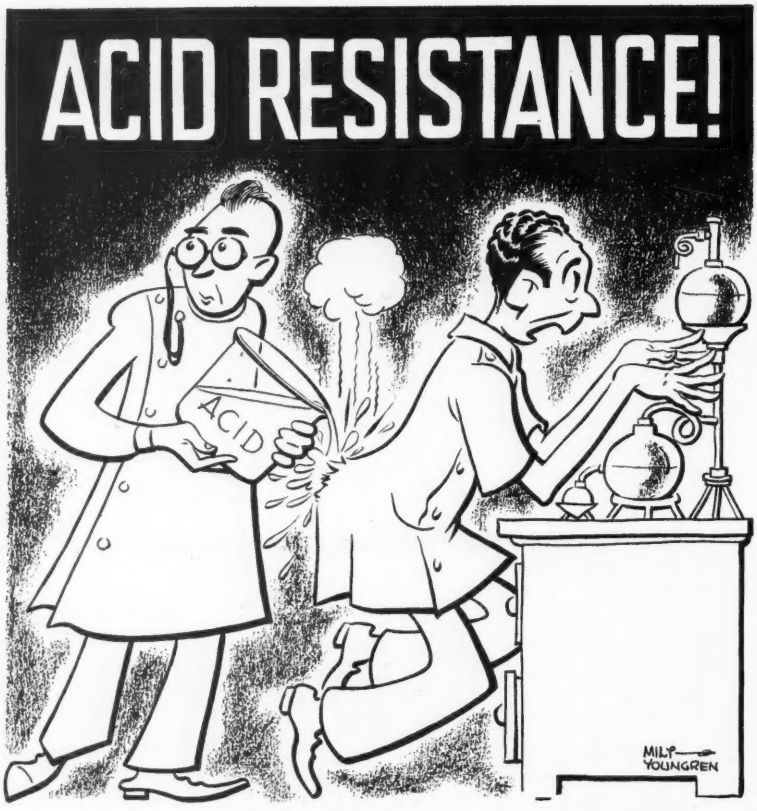
A careful analysis of the scales and sludges to be removed determines the type of solvent that will produce the most effective removal results. These carefully blended and inhibited compounds are transported in specially designed, mobile equipment and applied by a well-trained personnel.

DOWELL INCORPORATED, TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company



CONTACT DOWELL'S NEAREST OFFICE FOR COMPLETE INFORMATION

General Office, Tulsa 3; New York 20, 30 Rockefeller Plaza; Philadelphia 2, Girard Trust Bldg.; Cleveland 13, Terminal Tower Bldg.; Chicago 3, Field Bldg.; St. Louis, 2nd and Madison Sts.; Houston 3, 5315 Lawndale Ave.; Kansas City 8, Missouri, 220 B.M.A. Bldg.; Wichita 2, Union National Bank Bldg.; Mt. Pleasant, Michigan; Salem, Illinois.

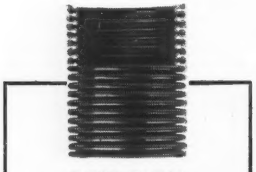


REX-FLEX Stainless Steel Flexible Tubing Is *Non-Corrosive*

REX-FLEX Stainless Steel Flexible Tubing was designed by Chicago Metal Hose Corporation to meet exacting military requirements. Its proved ability to successfully handle many types of corrosive gases and liquids and to withstand extreme heat, makes REX-FLEX equally desirable for the solution of *your* corrosion problems.

REX-FLEX is available in five wall forms, braided or unbraided. Fittings are resistance seam-welded to form uni-metal assemblies.

Why not take advantage of the experience of Chicago Metal Hose Corporation's engineers in adapting this versatile product to the wide range of problems requiring the stamina of stainless steel? They will be glad to give you their recommendations, without obligation. Write for complete information today.



REX-FLEX
STAINLESS STEEL
FLEXIBLE TUBING

Note These Features

- Corrosion resistance
- Extreme flexibility
- Pressure tightness
- Lighter weight
- Withstands extreme temperatures
- High fatigue resistance
- Seam-welded fittings

Flexible Metal Hose for Every Industrial Use

CMH
CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS

Plants: Maywood and Elgin, Ill.

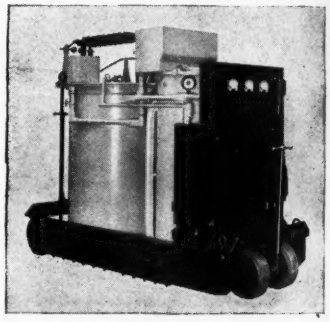
with any desired number. The new unit fits into and occupies the space heretofore required for a single unit of conventional design with very little increase in weight.

More compact applications incorporating variable resistors can readily be designed with these new multiple rheostats and potentiometers to facilitate centralized positive control of electrical units and provide improved operating efficiency and accessibility with a substantial saving in weight and space requirements.

Portable High-Voltage Testing Set

A NEWLY DESIGNED portable high-voltage testing set with a rating of 300 kva at 30,000 or 60,000 v has been announced by General Electric's Transformer Division at Pittsfield, Mass. The equipment is suitable for high-potential tests on generators, motors, cable, bus structures, and short sections of transmission lines.

Included in the equipment is a single-phase, oil-immersed 60-cycle transformer which supplies test voltages up to 30,000 or 60,000 v (series or multiple connection). The low-voltage winding of the transformer is rated 4600 v, and is supplied through a single-phase, oil-immersed induction voltage regulator, rated 75 kva, 60 cycles, 2300 v, 100 per cent raise and lower regulation. With a power input of 2300 v the regulator can vary the primary voltage of the testing transformer from 0 to 4600 v so that all tests can be started at zero voltage and then raised to any desired value up to 30,000 or 60,000 v. Approximately 40 sec is required for the motor to run the regulator from 0 to maximum.

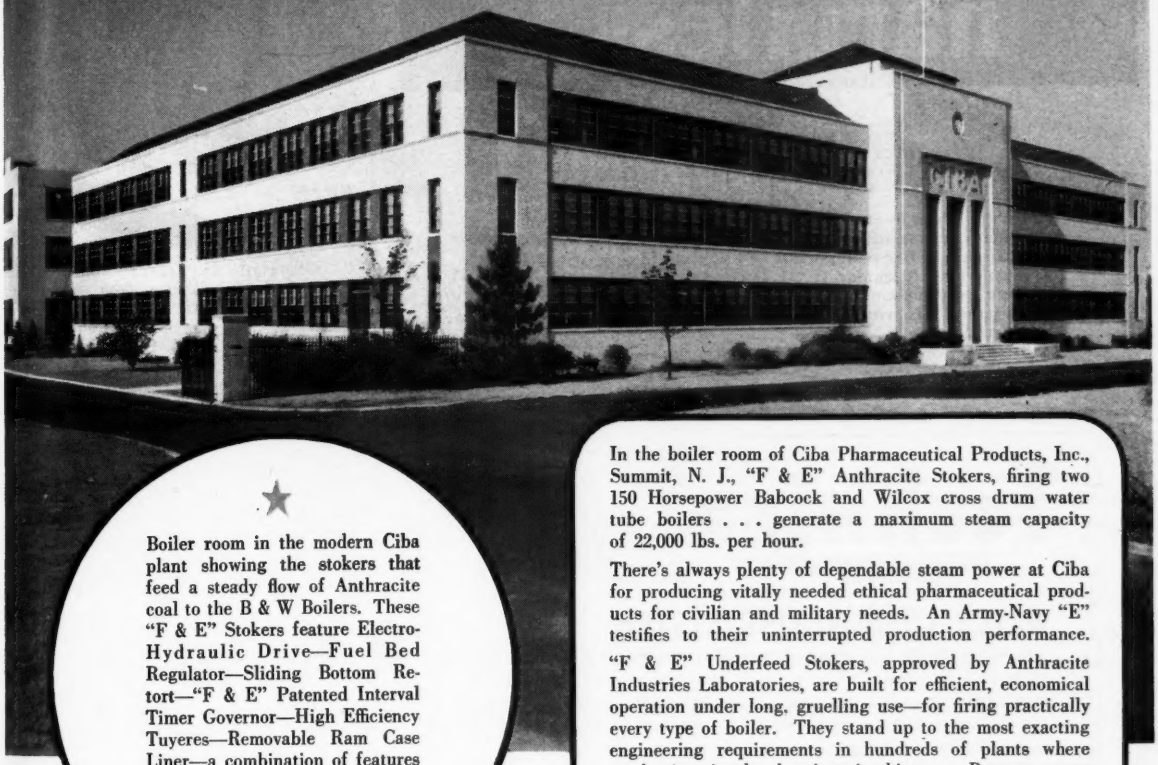


To help balance off part of the load charging current, the transformer is designed for 50 per cent magnetizing current, thereby permitting considerable reduction in the size and weight of the equipment for a given load.

Mounted at the front of the equipment is the control panel which contains an oil circuit breaker, ammeter, voltmeters, over-current relay, signal lights, and regulator motor switch. The output voltmeter reads directly in kilovolts, and is energized from a voltmeter coil built into the transformer high-voltage winding. To prevent the application of overvoltage to the apparatus under test an adjustable sphere gap is mounted on the transformer cover. Series or parallel connections of the high-voltage winding are made by means of links mounted on the tops of the high-voltage terminals.

The four-wheel truck on which the

22,000 LBS. OF STEAM PER HOUR WITH "F&E" STOKERS



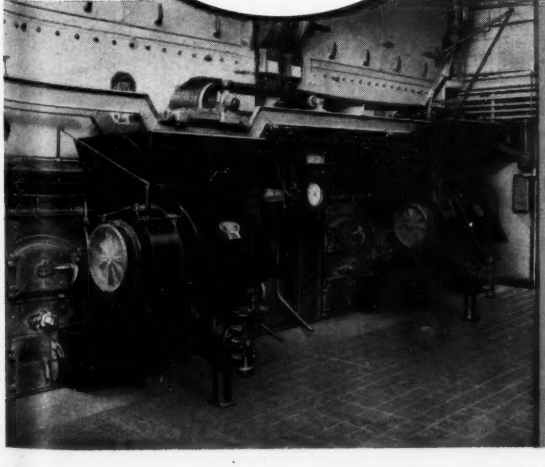
Boiler room in the modern Ciba plant showing the stokers that feed a steady flow of Anthracite coal to the B & W Boilers. These "F & E" Stokers feature Electro-Hydraulic Drive—Fuel Bed Regulator—Sliding Bottom Retort—"F & E" Patented Interval Timer Governor—High Efficiency Tuyeres—Removable Ram Case Liner—a combination of features found only in "F & E" Underfeed Stokers.

In the boiler room of Ciba Pharmaceutical Products, Inc., Summit, N. J., "F & E" Anthracite Stokers, firing two 150 Horsepower Babcock and Wilcox cross drum water tube boilers . . . generate a maximum steam capacity of 22,000 lbs. per hour.

There's always plenty of dependable steam power at Ciba for producing vitally needed ethical pharmaceutical products for civilian and military needs. An Army-Navy "E" testifies to their uninterrupted production performance.

"F & E" Underfeed Stokers, approved by Anthracite Industries Laboratories, are built for efficient, economical operation under long, gruelling use—for firing practically every type of boiler. They stand up to the most exacting engineering requirements in hundreds of plants where production is the heaviest in history. Because every "F & E" installation is engineered to the job, it is dependable, fool-proof, efficient and economical right from the word "go."

Your own consulting engineer knows about "F & E" Underfeed Stokers. Talk to him about their possibilities. Or—see the "F & E" representative in your territory.



F&E

UNDERFEED STOKERS

for boilers producing 1,000 to 40,000 lbs. of steam per hr.

are manufactured by

FLYNN & EMRICH CO.

Established 1842

HOLLIDAY & SARATOGA STREETS • BALTIMORE 2, MD.

Representatives in Principal Cities

REPRESENTATIVES WANTED in Virginia and the Carolinas. Attractive sales territories and interesting proposition now open to aggressive individual or firm. Write direct for details of franchise.

Just a drop of water-

harmless...

or is it?

Although specially treated for use in your water consuming equipment, it may still contain a sufficient amount of water hardness to cause boiler scale, priming, foaming, pitting or corrosion or caustic embrittlement.

There's no question about feed water conditioned by nature's own method discovered in the new TECHNICAL Water Conditioning System . . . a perfect balance of water's mineral content with correct, natural *organic substances.*

WATER CONDITIONING SYSTEM

TECHNICAL is a proven, natural system of individual formulas to fit each and every water type. It provides a special balance of water properties that definitely overcome scale, foaming, pitting, corrosion, priming, caustic embrittlement characteristic of boilers and condenser covering systems.

For your own satisfaction, investigate the new TECHNICAL System . . . Nature's own conditioning method developed under actual industrial operating conditions. Without obligation the coupon below will bring you the facts.

WATER TREATMENT COMPANY OF AMERICA

1159 Hedgkiss Street · Pittsburgh, Pa.

☐ Please send the new Technical System bulletin.

☐ Haye a Water Treatment Company engineer call.

Name_____ Title_____

Company_____

Address_____

equipment is mounted is provided with ball-bearing wheels with composition tires. The front axle is mounted on a ball-bearing swivel, for ease in turning.

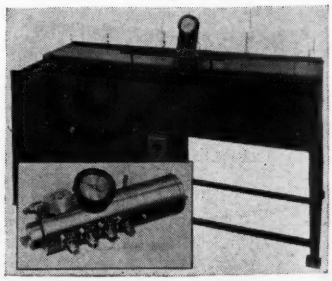
Micro pH Testing Set

OFFERING FACILITIES which, it is claimed, have never been available before in a colorimetric system, the new La Motte Micro pH testing set has recently been placed on the market by the La Motte Chemical Products Co., Towson 4, Baltimore, Md.

Some of the features of this new set are that it requires less than 0.5 ml sample, its accuracy is within plus or minus 0.1 pH, the turbidity and color in the sample do not interfere with the determination, time required for making a determination is one minute or less, the unit is compact and portable, and the unit is suitable for all kinds of solutions and general use.

Hydraulic Test Bench

HYDRAULIC TEST BENCH MODEL T-113 including an intensifier that is capable of developing up to 30,000 psi is announced by Hydraulic Machinery, Inc., 12825 Ford Road, Dearborn, Mich. The hydraulic circuit consists of a 2000 psi constant delivery pump (approximate delivery of gpm) which is directly connected to a manifold incorporated in the inlet and outlet of a high pressure intensifier, providing a preloading effect. The hydraulic intensifier operates at a ratio of 15 to 1, producing pressures up to 30,000 psi.



Included in this model of "Hy-Mac" extreme pressure intensifier are: Special high unit pressure connections throughout, no pipe threads or gaskets are employed, special balanced high pressure plunger and packless plunger sealing, special extreme pressure inlet check valve for charging the high pressure cylinder, multiple in-line high pressure connections for burst testing (four tubes or other parts simultaneously), high pressure gages and pressure release connections, "O" ring type packing on low pressure piston. The Bench is built of fabricated steel, equipped with drain

HOW AMERICAN INDUSTRY PRODUCES MORE, FASTER, BETTER WITH BOWSER EXACT LIQUID CONTROL

SAVED—A FLOOD OF PRECIOUS SOLVENT...*and costs cut to one-tenth*

A small ocean of paint is needed to protect planes and other war goods against rust and corrosion.

A Cleveland paint maker, irked at seeing much precious solvent wasted with dirty paint and residue (reclamation processes then used were prohibitively costly), looked for a practical solution . . . and called a Bowser Liquid Control Engineer.

A Bowser Still, basically similar to those which Bowser makes for the dry-cleaning industry, was recommended . . . and installed. With it, thousands of gallons of solvents were reclaimed at a cost of only a few cents per gallon, about one-tenth of the old cost. At that rate of saving, the Still paid for itself in its first 150 hours of operation.

For power plant operation, other Bowser Exact Liquid Control equipment—turbine oil conditioners, filters, force feed lubricators—give equally outstanding service.

Oil, continuously and thoroughly filtered by a Bowser Filter, is as good as new. Cornell University authorities, using a Thurston Lubricant Tester and also an Olsen Viscosimeter, made exhaustive comparative tests of new oil and of used, Bowser-filtered oil taken from a large power plant where severe conditions exist. They found the Bowser-filtered oil to be fully as good as new.

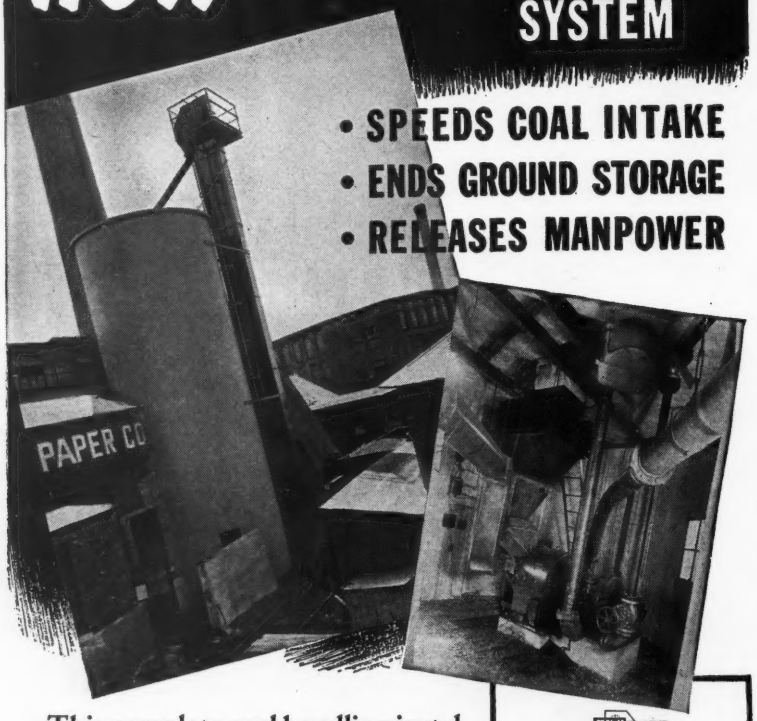
And here's an important point to remember—wherever your plant is located, you're close to a complete Bowser service organization. BOWSER, INC., Fort Wayne 5, Ind.

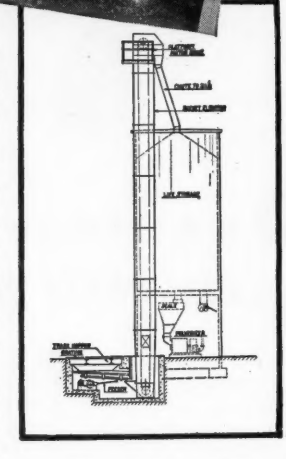
BUY WAR BONDS

THE NAME THAT MEANS **EXACT CONTROL** *OF LIQUIDS*

HOW A G-W COAL HANDLING SYSTEM

- SPEEDS COAL INTAKE
- ENDS GROUND STORAGE
- RELEASES MANPOWER





This complete coal handling installation for the Foster Paper Co. of Utica, N. Y. licked a shortage of space, eased a manpower situation, and thus led to expanded production.

Coal received direct from cars through a track hopper is fed to the elevator and raised to the overhead bin. It is then drawn to a scale, pulverized and discharged automatically into boilers. Completely mechanized, this Gifford-Wood system has a capacity of 50 tons per hour, eliminates ground storage and 90% of previous handling labor. The silo-protected coal doesn't absorb moisture or freeze. With the silo next to the boiler house, pulverizer located under live storage bin, a highly efficient setup is achieved.

Take advantage of Gifford-Wood's long engineering experience. Ask for a plan and proposal for a space and labor-saving system designed for your needs.

GIFFORD-WOOD CO.

FOUNDED 1814

420 Lexington Ave., New York 17 — HUDSON, N. Y. — 565 W. Washington St. Chicago 16

Ash Spouts • Barge Unloading • Bins • Boiler House Equipment • Buckets • Bunkers • Carriers • Chutes • Conveyors • Crushers • Elevators • Feeders • Gates • Ground Storage Systems • Hoists • Hoppers • Infra-Red Drying Systems • Screens • Silo Storage Plants • Tanks • Weigh Larries

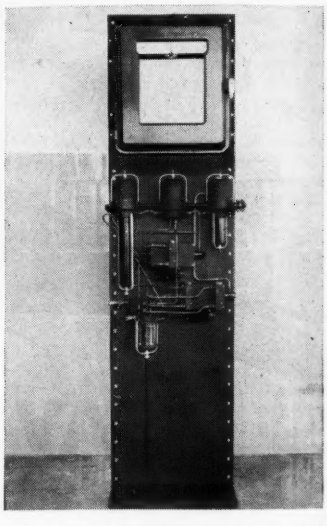
5372

pan, filters, and a rolling top of plexiglass which protects the operator when making burst tests. Gages indicate pressures directly off the pump and intensifier. Oil reservoir is provided with a filter, oil level gage, baffles and clean-out covers.

Gas Analyser for O_2, CO_2, CO and H_2

CAMBRIDGE INSTRUMENT CO., Grand Central Terminal, New York, N. Y., has recently developed an industrial 4-point gas analyser which provides simultaneous analysis and continuous graphic record of the amounts of oxygen, carbon dioxide, carbon monoxide, and hydrogen in a sample of combustion products. Chemicals, fragile glassware and moving parts in the analysis unit are eliminated.

The complete analyser operates directly from the alternating current supply line. The recorder may be located at any required distance from the sampling point and the instrument can be furnished with contacts for operating warning signals or to actuate various control circuits.



In theory the instrument accomplishes analysis by direct comparison of thermal-conductivity of the sample with that of a reference gas or by comparison of thermal-conductivity of the sample before and after chemical absorption or combustion.

This principle of operation permits units to be assembled to meet many special problems. In the operation of a typical unit a continuous sample of the gas is drawn into the analyser by means of a water bubbler-aspirator. The exact detail of the analysis procedure varies with the constituents of the sample but may involve a chemical absorption and/or combustion. The aspirator mentioned above not only draws in the sample gas but meters it, as well as the air which may be required for combustion in the analysis procedure. In all applications the results are recorded directly without any corrections or interpolation of any kind.

Glass Ring Jewels

GLASS RING JEWELS, developed by General Electric Co. for certain instrument bearings, have been announced as also available for many other applications by the company's engineers.

MILLIONS IN WAR SERVICE

FLEXITALLIC "C-G" GASKETS FOR HIGH-PRESSURE FLANGED JOINTS

The safe, sure sealing member for Raised-Face, Smooth Face, Van Stone or Cranelap fittings

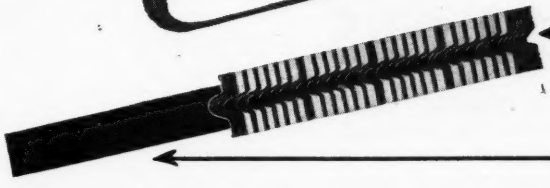
Seal is made and kept by spiral-wound, stainless-steel gasket which automatically expands and contracts with variations in temperature and pressure.

I.D. of gasket is clear of orifice at all points, offering no impediment in line.

Correct bonding load assured by surrounding solid-metal ring which serves as a thickness gauge for gasket when joint is made up.

Fit of surrounding ring, allows inner member to expand under compression.

Correct position assured by O.D. of gauge-ring which fits inside of bolts.



Construction of each spiral-wound member is governed by design of fittings and by the required bonding load for working pressure and temperature.

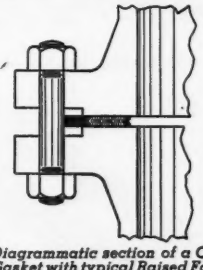
Gauge-ring saves installation time. Gasket is correctly installed when flanges are brought down to the ring in making up joint.

Most of the war service of Flexitallic Style C-G gaskets is in flanged joints aboard ship—as severe a service as can be found. Here steam is held despite weaving of the lines as the ship plows through the sea. Here loss of steam could cause disaster, not only locally but to the ship itself. It is service that involves huge responsibility for a gasket.

Come to know these C-G gaskets well. Time approaches when you will want the security in your lines that hundreds of ships now have. We will be glad to send you a leaflet about them; just say Style C-G Flexitallic Gaskets.

"Flexitallic" Reg. U.S. Pat. Office

Representatives in Principal Cities



Diagrammatic section of a C-G Gasket with typical Raised Face fittings showing the flanges compressed to the thickness of the solid metal member.

FLEXITALLIC GASKET CO., 8th and Bailey Streets, Camden, N. J.

Originators of Spiral Wound Construction

The glass ring jewels are an outgrowth of the work in developing glass vee jewels, introduced recently by the company as the answer to the shortage of foreign-made sapphire bearings. The ring jewels, like the vee jewels, are reported to be superior to sapphire in many respects and are available at approximately one-third the cost. The ring jewels are supplied ready to set at $1.20 per 1000. They can be press-set or spun-set into bearing plates and other elements in the same manner as sapphire rings.

Surface of the hole in the glass ring is fire-polished in manufacture and is not touched subsequently. The flat surface opposite the "bell end" of the hole is highly polished by brushing with a suitable abrasive. This surface is also slightly chamfered at the edge of the hole

and at the outside edge of the jewel. Outside diameter of the opposite flat surface of the jewel is also slightly chamfered to facilitate press setting and to avoid a fragile edge which might easily chip in transportation.

Dimensions are held to extremely fine tolerances; concentricity of the inside and outside diameters of the bearings is unusually accurate. The five sizes of bearings listed include three outside diameters: 0.100 in., 0.0787 in., and 0.064 in. Rings have been made experimentally in sizes up to 0.5 in. outside diameter, and holes have been molded down to 0.005 in. diameter.

OBITUARIES

George G. Higbee

GEORGE G. HIGBEE, President of the Murray Iron Works Co. since 1911, died on February 3, 1944. Mr. Higbee succeeded his father, Colonel J. H. Higbee who founded the company and incorporated it in 1870.

In his position as president of the company, Mr. Higbee was deeply interested in the production of only the highest grade of power plant equipment, which originally included steam engines, later Corliss engines and then steam turbines and boilers of all types. A large gray iron foundry, operated by the company, was always under Mr. Higbee's direct charge, and he had been an ardent supporter of foundry associations.

N. S. Taylor

NEWTON S. TAYLOR, 55, an executive in the Switchgear and Control Division of the Westinghouse Electric and Manufacturing Company, died February 21 in his home, 1800 Graham Boulevard, Wilkinsburg, after an extended illness.

Mr. Taylor, a native of Lancaster, Ky., was graduated from the University of Kentucky in 1909 with the degree Bachelor of Mechanical Engineering. He entered the student course at the Westinghouse East Pittsburgh works the same year. At its completion, he became a member of the switchboard sales department.

Except for a few years in Denver, Colorado, where he was a switchboard specialist, Mr. Taylor has been stationed at East Pittsburgh for 35 years, serving as manager of the switchboard section, head of the large oil circuit breaker and switchboard section, manager of switchgear apparatus and, more recently, supervisor of switchgear order service.

On December 14, 1942, Mr. Taylor received the Westinghouse Order of Merit from A. W. Robertson, chairman of the board of the company, for his outstanding work in speeding delivery of circuit breakers and other equipment to the U. S. Navy and war industries.

F. W. Goetze

F. W. GOETZE, President of The Goetze Gasket & Packing Co., Inc., of New Brunswick, N. J., died suddenly of a heart attack on January 30, 1944.

Mr. Goetze was born at Burscheid, Germany, November 17, 1891, but was a naturalized American citizen. He was graduated from the Technical College of Coethen, Germany, in 1914, with a bachelor's degree in mechanical engineering. He was a member of the American Society of Mechanical Engineers. In 1923, he became president of The Goetze Gasket & Packing Co.

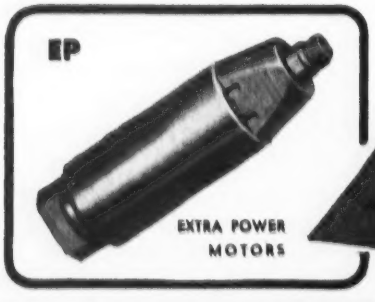
His hobby was research and invention, consequently, he established one of the most up-to-date technical research laboratories and staffed it with expert technologists, whose sole duty is to keep the Goetze line in step with the most advanced engineering practice.

WILSON TUBE CLEANERS

for each of these Power Sources

Wilson Tube Cleaners, with a complete range of cutter heads, brushes, drills and cleaners are available for use with all power sources—air, steam, water and electricity.

Modern tube-cleaners for the problems of today.

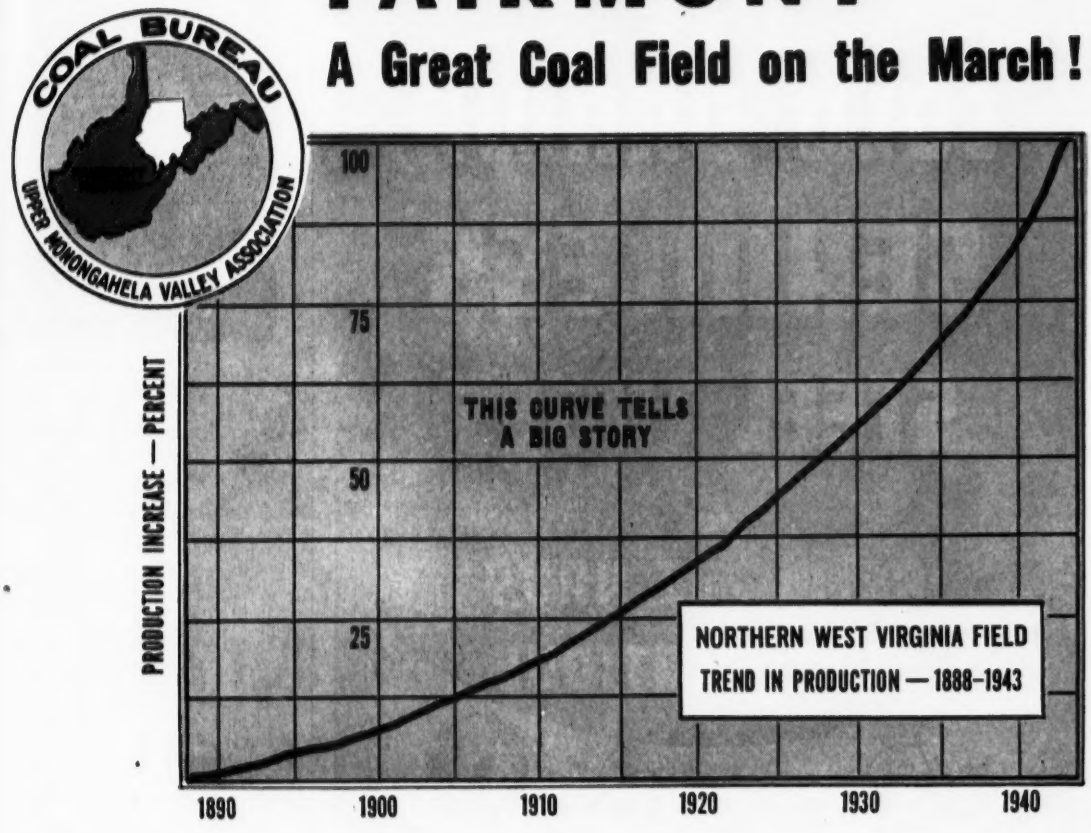


wilson

THOMAS C. WILSON Inc.
21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

FAIRMONT

A Great Coal Field on the March!



Huge Reserves + Thick Coal + Mechanized Mining + Modern Preparation = Economy for the Consumer

Request a complimentary subscription to the "Reference Bulletin," published serially by the Coal Bureau. These up-to-the-minute bulletins describe, with illustrations, actual case histories of modernized boiler plants, and discuss such important subjects as coal sizing, size and price relationships, preparation, coal selection, specifications, combustion and fuel conservation.

THE COAL BUREAU FUEL ENGINEERS CAN HELP YOU

You are invited to draw on the experience of the Bureau's staff of Fuel Engineers in connection with post-war planning for boiler plant modernization and long-range fuel programs.

A Great Steam Coal!

COAL BUREAU—UPPER MONONGAHELA VALLEY ASSOCIATION

CHANIN BUILDING, 122 E. 42nd ST., NEW YORK, N. Y.

Pittsburgh—The Greatest Seam in the Greatest Bituminous Producing State—West Virginia

PTP
COLD DRAWN
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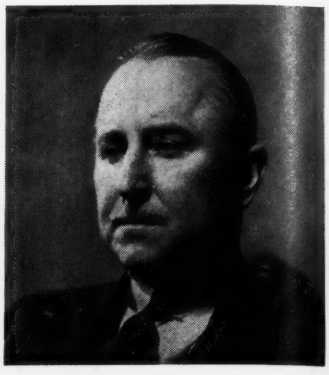
When writing advertisers for catalogs, descriptive bulletins or prices, please remember to say, "I saw your message in POWER PLANT ENGINEERING." Thus you'll do a good turn for the advertiser and for this publication. . . .

James E. McDonald



JAMES E. MCDONALD, 53, for many years general sales manager of The Edward Valve & Mfg. Co., Inc., East Chicago, Ind., died February 25 at Mercy Hospital, Chicago, after an illness of several months.

Mr. McDonald, who joined the Edward organization in 1917 had a vital part in the development of steel valves for high temperature and pressure services in steam generating, refinery processing, chemical and paper industries, and in the extreme pressure hydraulic field. Starting as a draftsman in the Edward engineering department he advanced rapidly through the positions of chief engineer, shop superintendent and then general sales manager.

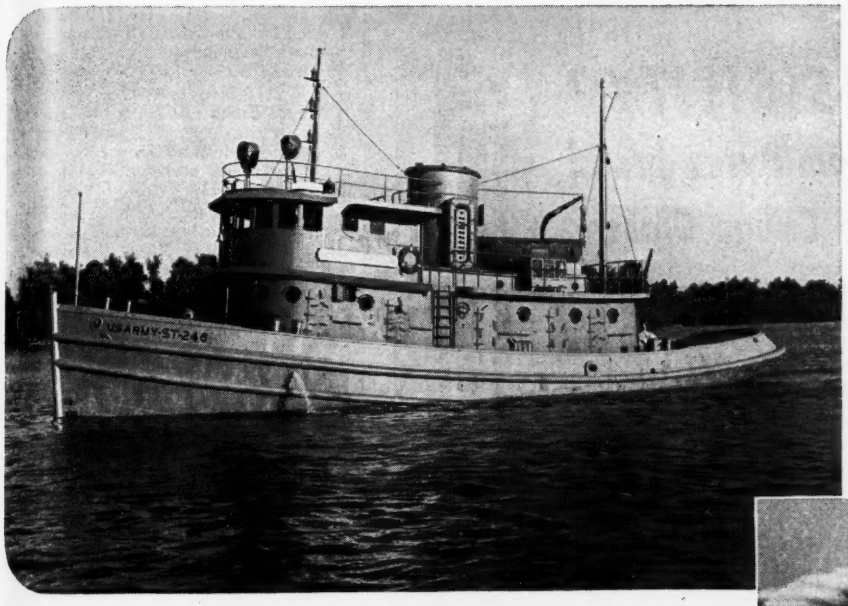
Known to power men from coast to coast, he had made many contributions to the progress of power engineering. He was an authority on pressure drop and was an early advocate of streamlined piping and valve design. He played a part in the design of the Impactor valve handwheel for closing large valves against high pressures, and was instrumental in the development of many Edward patents.

A graduate of the University of Illinois College of Engineering in 1914, he was a member of the American Society of Mechanical Engineers, Phi Kappa, Knights of Columbus, Flossmoor Country Club and South Shore Country Club of Chicago.

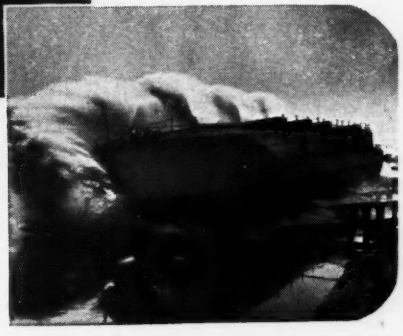
MANUFACTURERS' PERSONALS

George W. Kelsey has recently been elected a member of the Board of Directors of Builders-Providence, Inc. Mr. Kelsey continues as General Sales Manager of the company, a position he has held for several years. Builders-Providence, Inc., is located at Providence, R. I.

Allan Barringer Hendricks, Jr., who designed the first million-volt testing transformer equipment used in General Electric's Pittsfield Works, has retired from the company after 43 years of service in lightning research. Mr. Hendricks was assistant engineer on high-voltage testing apparatus, Power Transformer Engineering Division, at the time of his retirement. He was employed by the Stanley Co. as head of the Testing Department when that company was merged into G. E., in 1906. As a member of the Pittsfield Works Laboratory he built the first



Busch-Sulzer Diesels are being installed in Army towboats, of the type pictured (left), used in securing beachheads. The all-steel lighter (below), launched by a St. Louis shipbuilding concern, will be filled with supplies from transports in the war zones and towed ashore.



She Has Something Else In Tow ...SKILL FOR THE FUTURE

To build engines for towing craft like that pictured here ... and other engines for the Navy ... and naval ammunition hoists with watch-like precision mechanism ... we greatly expanded our facilities and increased our trained personnel by 50 percent within the last 18 months.

May we suggest that you begin now to familiarize yourself with your postwar requirements and acquaint us with them in good time?

For the last three years, our total output naturally was devoted to orders for the Navy, Army, Maritime Commission and projects connected with the war effort. While the need exists, such work will have first call on our full capacity, but when this demand slackens our facilities and our personnel can be devoted immediately to your requirements. Obsolescence and the need for power in new enterprises plus the fact that many Diesel manufactories in other countries have been damaged or destroyed will result in a huge demand for engines. Your inquiry at this time will enable us to plan so that there need be no delay in filling your needs as soon as capacity is available.

BUSCH-SULZER BROS.—DIESEL ENGINE COMPANY
SAINT LOUIS

AMERICA'S OLDEST BUILDER OF DIESEL ENGINES

BUSCH-SULZER ST. LOUIS

EXTRA VISIBILITY?

Get it from Pyrex brand Broad Red Line Gauge Glasses

When you want extra visibility, call for PYREX brand Broad Red Line Gauge Glasses. You don't have to guess where the water line is, because it stands out vividly. You can't miss it, even from a distance.

Illuminated from the rear, the transparent Broad Red Line is greatly magnified by the water column. There's no doubt and no eye strain with PYREX Broad Red Line Gauge Glasses.

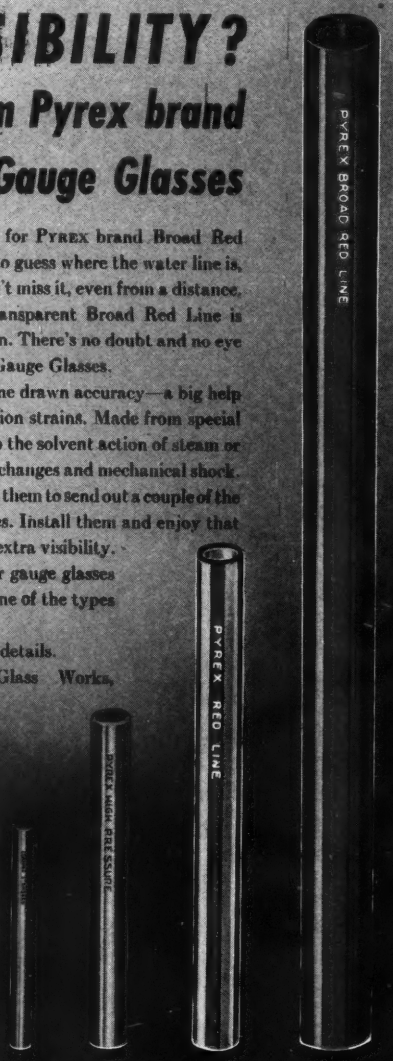
These glasses are made with machine drawn accuracy—a big help in preventing breakage from installation strains. Made from special borosilicate glass, they are resistant to the solvent action of steam or hot water and to sudden temperature changes and mechanical shock.

Call your Mill Supply House and tell them to send out a couple of the PYREX Broad Red Line Gauge Glasses. Install them and enjoy that feeling of security which results from extra visibility.

Whatever particular condition your gauge glasses must meet, you'll find the answer in one of the types in the CORNING and PYREX Line.

Write for Bulletin 817. It gives full details.

Industrial Division, Corning Glass Works, Corning, N. Y.



PYREX brand High Pressure—resistant to thermal and mechanical shock and attack of steam and hot water. Machine drawn accuracy.

PYREX brand Red Line—Same but with added visibility afforded by enameled red line.

PYREX brand Broad Red Line—Same but with fused-in broad red line for extra visibility.

CORNING Standard—For moderate pressures. Long-lasting. Machine drawn accuracy.

"Pyrex" and "Corning" are registered trade-marks and indicate manufacture by Corning Glass Works.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses
BRAND

The more you GIVE

—the more will LIVE

1944 RED CROSS FUND

testing transformer for 150,000 volts. Under his guidance, all of the transformers used in the high-voltage tests operating up to 1,000,000 and 1,500,000 volts were designed.

M. E. Finck has been chosen president of the Murray Iron Works Co. to succeed the late George G. Higbee, who had been president of the company since 1911.

E. W. Potratz has been appointed manager of the Hoist Sales Division, of Harnischfeger Corp., Milwaukee, having been advanced from the position of acting sales manager. He joined the Harnischfeger hoist division as an estimator in 1935, and in 1939 was named assistant sales manager. Prior to joining Harnischfeger, Potratz was employed in product engineering and development with several leading industrials in the middle west.

Appointment of Corliss A. Bercaw as assistant general manager of Elliott Co., Springfield, Ohio Division, is announced by G. L. Elliott, general manager. Mr. Bercaw, former Baldwin Locomotive and Westinghouse executive, was born in Holgate, O, and received his B. S. degree in Mechanical Engineering at California Instituute of Technology. A naval ensign and aviator in World War I, he joined Westinghouse after his discharge from service, as an engineer, and became special representative of the Diesel engine division. He was associated with the Baldwin Locomotive Works as sales manager of Diesel locomotives and later production manager of the Diesel engine division before joining Elliott Co.

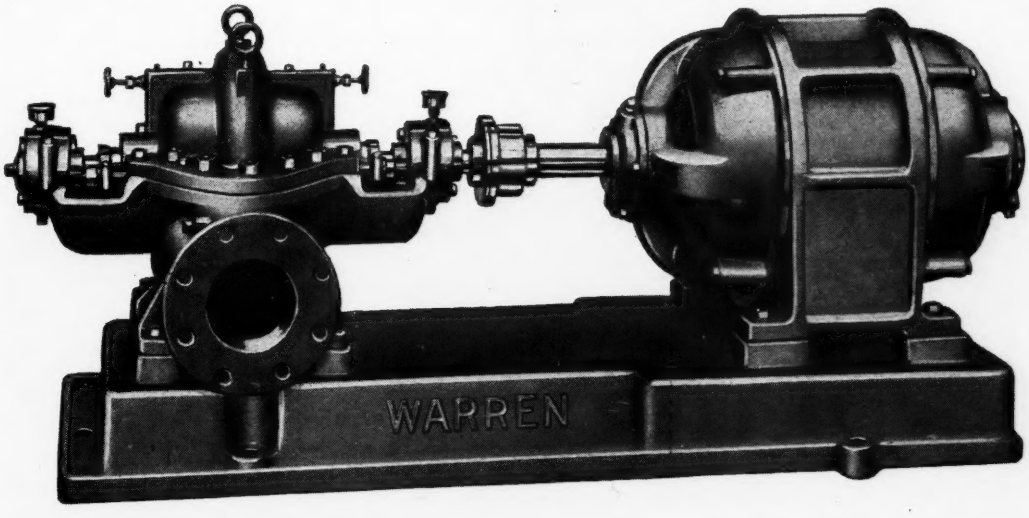
R. P. Exten has joined the Young Radiator Co. of Racine, Wis. Mr. Exten received his early training in the automotive and accessories fields serving in various capacities with the Studebaker Corp., Timken-Detroit Axle Co., and the Hudson Motor Car Co. He was more recently associated with the Climax Engineering Co. as chief draftsman and assistant engineer and the Mechanics Universal Joint and Rockford Drilling Machine Divisions of the Borg-Warner Corp. as production engineer. In his new position, Mr. Exten will devote himself particularly to production matters.

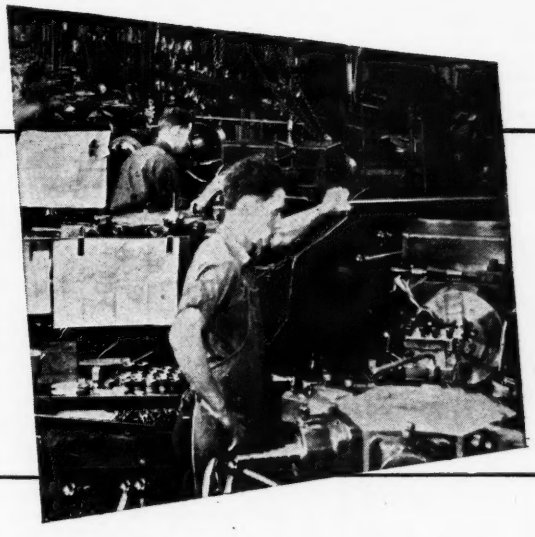
T. C. Knudsen has been named manager and chief engineer of the new Texrope Department established by Allis-Chalmers Mfg. Co., Milwaukee, Wis. The new department, which will handle the Texrope line of multiple V-belts and sheaves, was established as part of a reorganization move. Mr. Knudsen has been closely associated with the Texrope Drive from its inception and played a major part in its development. He joined in 1922, as a member of the Milling Machinery Department.

William P. Newman, purchasing agent of Robins Conveyors, Inc., was recently honored by his associates at a luncheon held in the Passaic City Club in celebration of his 45th Anniversary with that company. Mr. Newman started as office boy at Robins, after having served in a similar capacity for Thos. A. Edison for a few years. He has been purchasing agent for the past 36 years.

Charles Schwarzler has been made manager of the Export Department of the Foxboro Co., Foxboro, Mass., succeeding Henry B. Moelter who

Here's A High Speed
WARREN PUMP
That Is Well Worth Looking Into Now





The boys in the Warren Acme Lathe Department like *all* Warren employees, are proud of our Army-Navy "E" Award . . . proud of the star recently added for continued production efforts.

Since more and more Warren Pumps are now being made available for commercial purposes, a timely tip is to look into Warren Pumps for your *own* future use.

The Warren Pump featured here is a single stage double suction pump, type DBH, specially designed for high speed operation and heads up to 300 feet.

Its *impeller* is accurately machined and balanced to insure freedom from vibration . . . with all water passages hand finished. Case *rings* are of cast bronze of the nozzle type with joint between case rings and impeller forming a labyrinth seal . . . securely held in place by tongue and groove lock in the lower half of pump casing. *Bearings* are of ball type held against pump shaft shoulder by means of locknuts and washers.

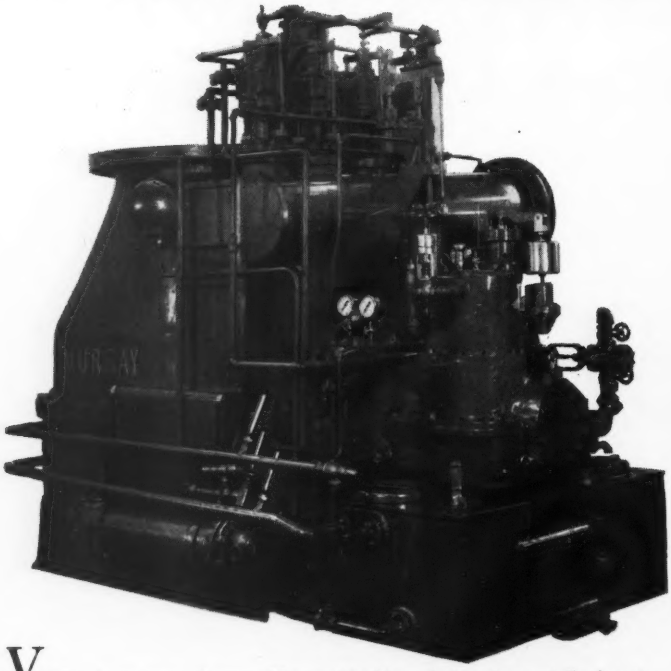
Every Warren Pump is given a complete running test and all guarantees verified before shipment. Write for further information about Warren Pumps as they would apply to your particular problems.

ARMY "E" NAVY

WARREN STEAM PUMP CO., INC.
WARREN, MASSACHUSETTS

MURRAY TURBINES

For Air Conditioning Compressor Drive



VIEW shows one of many Murray Turbines designed especially for air conditioning compressor drive. This unit develops 1000 h.p. at 4 lb. initial pressure, 26 in. vacuum and 4100 r.p.m. It is equipped with variable speed, oil pump, oil relay governor; automatic nozzle control; auxiliary turbine driven starting oil pump; vacuum breaker actuated by overspeed governor; solenoid trip to stop turbine in case of abnormalities in the refrigeration system. Governor includes automatic control which maintains even temperature of the system's cooling medium by varying the capacity of the compressor through the speed. Steam inlet is 12 in. and exhaust outlet is 36 in. arranged in an upward direction.

Other Murray Turbines are driving air conditioning compressors at 8000 r.p.m., or have extraction or extraction mixed pressure gear to maintain the proper heat balance in the plant. Write for descriptive bulletin.

BOILERS ENGINES MACHINERY

MURRAY
IRON WORKS COMPANY
INCORPORATED 1870
BURLINGTON IOWA

CHANGE OF ADDRESS

To avoid missing an issue or paying for forwarding postage be sure to send a change of address to our office. Changes received by the 20th of the month can be made effective for following month's issue.

POWER PLANT ENGINEERING

died January 20, following a brief illness. Mr. Schwarzler, formerly manager of the Sales Promotion Department, is a trained engineer, with ten years of experience in the application, promotion and sale of Foxboro instruments.

Robert A. Campbell has been appointed sales manager of the Steel Tube Division of Talon, Inc., Oil City, Pa. The new sales manager, a native of Youngstown, O., comes from the Ohio Seamless Tube Co. at Shelby where he had been assistant sales manager for the past seven years. During the three years prior to that time, he was assistant sales manager of Standard Tube Co., Detroit, Mich., and for five years before then he was with Republic Steel Corp., Steel and Tube Division, Cleveland, O.

B. W. Paul, with offices at 43 E. Ohio St., Chicago, Ill., will have charge of the Chicago Metropolitan Sales Office of the McClave Co., manufacturer of stokers and grates.

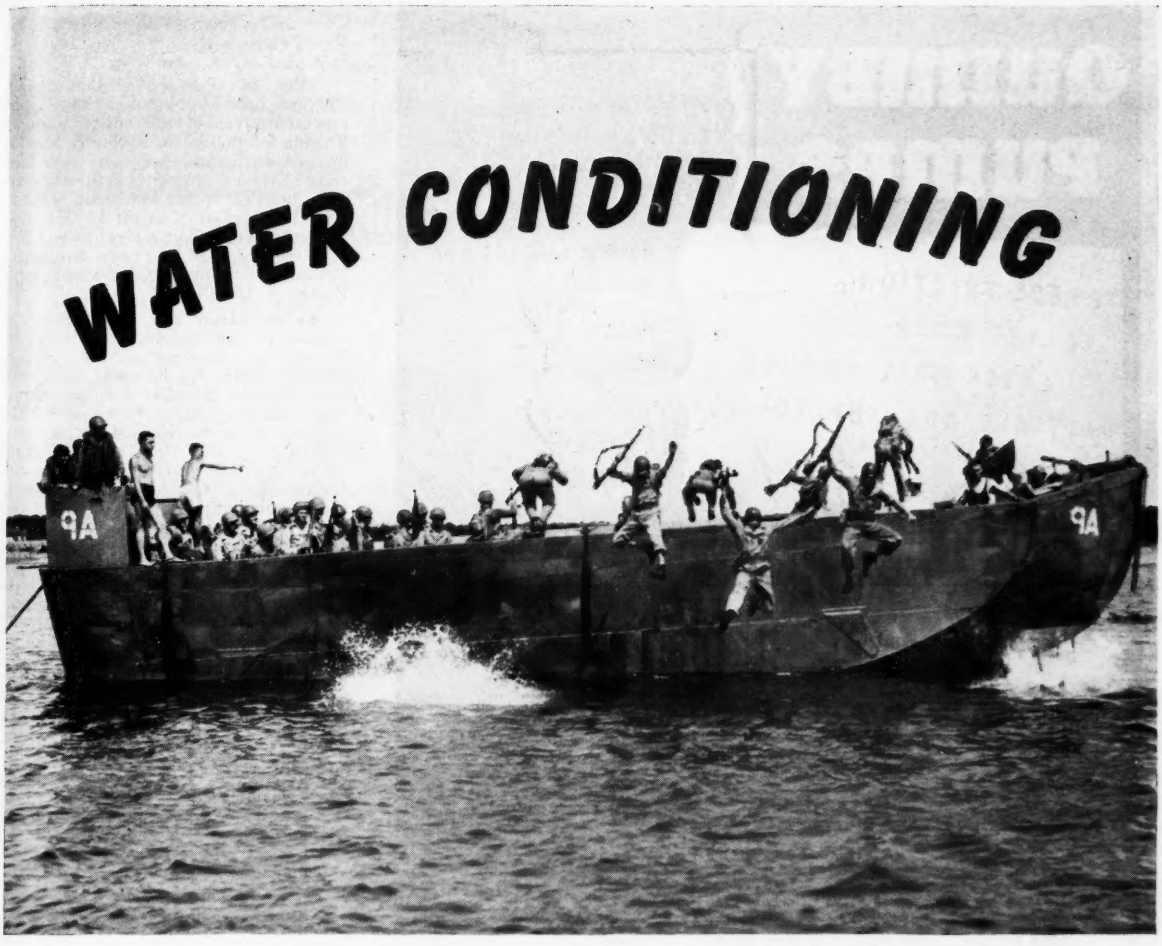
Charles L. Tolles has been elected president and George E. Bean secretary and treasurer of the Jewell Belt Hook Co., Nangatuck, Conn. W. D. Calvert was appointed cashier and D. G. MacVicar, sales manager, according to an announcement from the Board of Directors at the annual meeting which preceded the Directors' meeting. Charles L. Tolles, who is also president of the Hartford Belting Co., George E. Bean, L. A. Dibble, Emil Mannweiler and E. M. Beecher were elected Directors for the ensuing year.

Bruno R. Neumann, until recently Senior Economist with the Planning Division of the War Production Board, has joined the National Foremen's Institute, Inc., Deep River, Conn., as Labor Economist and Editorial Director. He will make his headquarters at the company's editorial office, 527 Fifth Avenue, New York, N. Y. Mr. Neumann will head up the Institute's research and consulting service on labor economics and labor relations. The Foreman's Letter and the Executive's Labor Letter will be under his editorial direction. Prior to his service with the War Production Board, Mr. Neumann was a member of the economic research staff of the National Association of Manufacturers. His experience abroad includes intimate familiarity with economic and labor relations problems in Great Britain and other European countries as well as the United States.

William W. Small has recently joined the Power Specialty Co., 1536 Mellie Esperson Bldg., Houston 2, Texas, as an application and service engineer. Mr. Small is a graduate of Texas A & M College from which he received a Bachelor of Science Degree in Chemical Engineering. Mr. Small will be sent into the field to help with engineering applications and service on the products the company handles. The Power Specialty Co. represents Cochrane Corp., Centrifix Corp., Erie City Iron Works, Foster Engineering Co., Hays Corp., Henszey Co., J. E. Lonergan Co., Lummus Co., R-S Products Corp., and Thomas C. Wilson, Inc.

R. L. Lewis has joined Economy Equipment Co. with offices in St. Louis and Kansas City, Mo., which represent Cochrane Corp., Crosby Gauge & Valve Co., Foster Engineering Co., Hays Corp., Key Co., Northern Equipment Co., Reliance Gauge Column Co., Taylor Instrument Co., Vulcan Soot Blower Corp., Webster Engineering

WATER CONDITIONING



● Water conditioning tactics developed for the protection of our invasion troops have no place in your power plant... but... there are modern water conditioning methods available to industry which bring equally valuable end results.

Water that is conditioned to remove objectionable dissolved minerals, hardness, corrosion, oil, suspended matter, etc. will protect your production schedules, safeguard irreplaceable power plant equipment, save precious fuel and reduce labor costs.

The power plant, so vital to the war effort, can have the protection of Infilco equipment for boiler or evaporator feedwater treatment, cooling water conditioning, condensate oil removal, steam purification, etc.... as well as Infilco chemical feeders and trade waste treating equipment. You are invited to make use of Infilco's 49 years experience in these allied fields. Call on our Engineering Staff. There is no obligation.

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INCORPORATED

325 W. 25TH PLACE, CHICAGO, ILL.

INFILCO

ACCELATOR SOFTENERS • CHEMICAL FEEDERS • PROPORTIONERS
WATER FILTERS • CLARIFIERS • COOLING WATER CONDITIONERS
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LIME-SODA SOFTENERS • ZEOLITE SOFTENERS • CATEXERS

ARMY NAVY

QUIMBY PUMPS

SCREW
ROTEX
CENTRIFUGAL
CHEMICAL

√ LESS FRICTION
√ LESS WEAR
√ LESS MAINTENANCE
IT ALL ADDS UP TO . . .

Longer Life!

QUIMBY VERTICAL SCREW PUMP

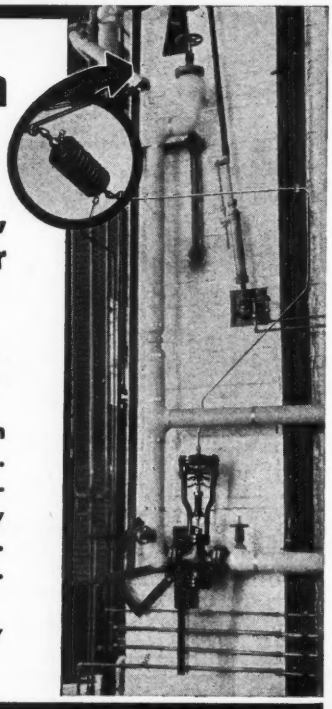
QUIMBY PUMP COMPANY
INCORPORATED

Division of H. K. PORTER COMPANY, Inc.
PITTSBURGH, PENNSYLVANIA
FACTORIES:
PITTSBURGH, PA. NEWARK, N.J.
BLAIRSVILLE, PA. NEW BRUNSWICK, N.J.

With No Drain on Power—

you can have safe, accurate Feed Water Regulation with

Swartwout



***(1)* Simplicity of construction avoids complicated adjustments. *(2)* Ruggedly built to operate under severe conditions. *(3)* Easily adjusted to varying conditions. *(4)* Easy to install on any boiler.**

Write for Bulletin S-20-D.

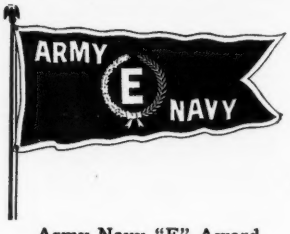
THE SWARTWOUT COMPANY
18511 Euclid Ave. Cleveland 12, Ohio

Swartwout POWER PLANT EQUIPMENT

Co., and Thomas C. Wilson, Inc. Mr. Lewis will operate in both the St. Louis and Kansas City territories.

John G. Pastor of Jacksonville, Fla., has been appointed exclusive sales representatives in the entire State of Florida for the entire Kieley & Mueller line of automatic pressure and level control valves and equipment. The appointment of W. E. Marmaud, 2832 E. Grand Boulevard, Detroit 11, Mich., as sales representative in Detroit and part of Michigan, also has been announced by A. E. Campbell, sales manager of Kieley & Mueller.

Bailey Meter Co., Cleveland, O., announces the appointment of N. M. Barnett as manager of its Chicago Branch Office. He succeeds M. Greenberg, former manager whose resignation became effective February 1. Mr. Barnett is a mechanical engineering graduate of the University of Kentucky and has been connected with Bailey Meter Co. for over 20 years. He was manager of the company's Detroit office prior to his transfer to Chicago. The vacancy created by Mr. Barnett's transfer to Chicago has been filled by Ralph T. Cowan, formerly of the Detroit and Cleveland Sales offices of Bailey Meter Co. Mr. Cowan, who is a graduate of Case School of Applied Science, has also specialized in the problems involved in applying metering and automatic control equipment to power plants and industrial processes.



Army-Navy "E" Award
The Bristol Company*
Waterbury, Conn.
Bryant Electric Company
Bridgeport, Conn.
Cochrane Corporation
Philadelphia, Pa.
The Cooper-Bessemer Corp.
Mount Vernon, Ohio and
Grove City, Pa.
Jenkins Bros.*
Bridgeport, Conn.
Philco Corp.
Storage Battery Div.
Trenton, N. J.
Warren Steam Pump Co., Inc.
Warren, Mass.

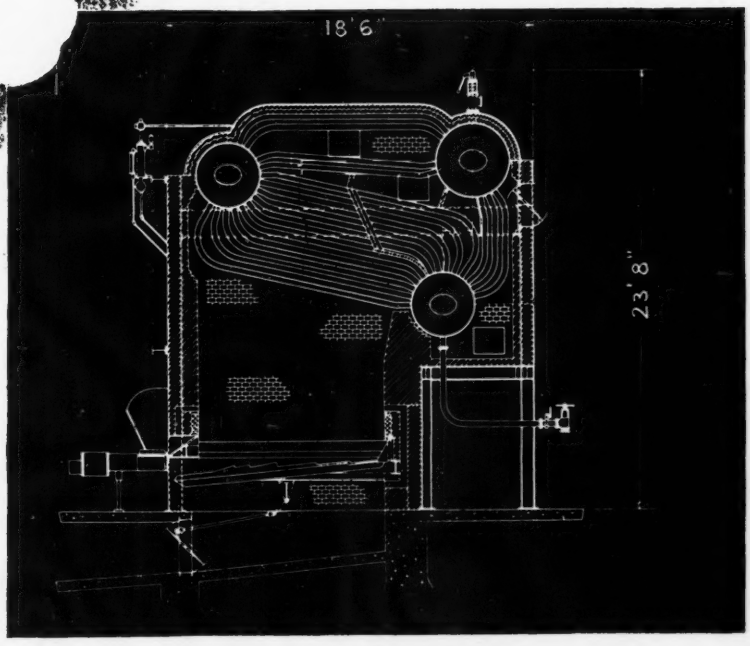
Maritime Commission "M" Award
The Edward Valve & Mfg. Co., Inc.*
East Chicago, Ind.
Jenkins Bros.*
Bridgeport, Conn.
Trill Indicator Co.*
Pittsburgh and Corry, Pa.

National Security Award
Indianapolis Power & Light Co.
Indianapolis, Ind.
Montana Power Co.
Butte, Mont.
Pennsylvania Power Co.
New Castle, Pa.
Philadelphia Electric Co.
Philadelphia, Pa.
Westinghouse Elec. & Mfg. Co.
Nuttall Works
Pittsburgh, Pa.

*Star added for sustained high achievement in production of war equipment.

PROBLEM:

To increase steam output despite low head room.



SOLUTION:

Installation of Edge Moor Low Head Boiler.

To provide increased steam requirements, a paint and varnish plant installed a 285 hp Edge Moor Low Head Water Tube Boiler. This three drum unit went into virtually the same space formerly required for two 80 hp boilers. This installation has delivered up to 12,000 lbs. of steam per hour at 8 to 10 lbs. pressure.

To meet the requirements of moderate capacities and rapid change in loads, four series of Edge Moor Low Head Boilers are offered in a range of sizes from 100 to 600 hp and for any working pressure up to 900 pounds, for use with any type fuel.

Many other Edge Moor boilers—in a wide range of types, capacities, pressures and accessory equipment—are available. Send us details covering your requirements for prompt quotation. Write!

STEAM GENERATING EQUIPMENT

EDGE MOOR
IRON WORKS, INC.

BRANCH OFFICES: NEW YORK 20, N. Y.: 30 ROCKEFELLER PLAZA
CHICAGO 2, ILL.: ONE NORTH LA SALLE STREET

MAIN OFFICE: EDGE MOOR, DELAWARE

Long-distance control wastes time and labor in tube cleaning

Roto offers you operating control of tube cleaners where you need it most, right at the cleaner. An air valve, directly behind the Roto motor, permits the operator himself to turn air on and off instantly, eliminating the helper and saving time ordinarily lost by signalling. The advantages of Roto Tube Cleaners are particularly noticeable where a number of them are in simultaneous operation. Why not enjoy the time- and labor-saving features of Roto Tube Cleaners now, when you need them most?

ROTO

TUBE CLEANERS

The ROTO Company
145 Sussex Ave., Newark 1, N. J.

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THE PACKING THAT "PACKS ALL"

. . . use it once and
. . . you'll use it always

THE ALLPAX CO., INC.
Mamaroneck, N. Y.

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Distributors Everywhere

Here's the universal packing that can be used for any fluid or on any apparatus—economically, efficiently—tightly—simply.

Try ALLPAX and you, too, will be enthusiastic over its easy application and long wear. You don't have to remove old packing to repack with ALLPAX. Square cross section makes ALLPAX easy-filling in any stuffing box.

Try it and you'll always use it. Full details on request.

MANUFACTURERS' NEWS

Kieley & Mueller, Inc., has appointed Albert J. Lilygren, 558 First Avenue South, Seattle, Wash., exclusive sales representative for the States of Oregon and Washington. The Lilygren organization will distribute the entire K & M line of level controls, strainers, pressure regulating and reducing valves, steam traps, pump governors, and power plant equipment.

M. F. Waters, president of Hanlon-Waters, Inc., Tulsa, Okla., announced that at the annual meeting of the company held at Tulsa, February 22, Edward F. Deacon, president of Climax Engineering Co., Clinton, Iowa, and The McAlear Manufacturing Co., Chicago, Owen L. Coon, Chairman of the Board of General Finance Corp., Chicago, and James E. Allison, attorney for the Hanlon Interests, were elected to the Board of Directors of Hanlon-Waters, Inc. The old officers of the company, consisting of E. I. Hanlon, Chairman of the Board of Directors, M. F. Waters, president, and J. H. Boyle, treasurer, were re-elected. J. E. Allison, attorney for the Hanlon Companies, was elected secretary. L. J. Griffey, who has been chief engineer of Hanlon-Waters, Inc., for ten years, was made vice-president and C. W. Snyder was appointed chief engineer.

Builders-Providence, Inc., of Providence, R. I., and Omega Machine Co. of Kansas City, Mo., affiliated companies, announce that W. D. Taulman & Associates, 610 Red Rock Building, Atlanta, Ga., will handle the products of both concerns in Eastern Tennessee and in the states of Alabama, Florida, and Georgia. The Florida office of W. D. Taulman & Associates is located at 1463 Talbot Ave., Jacksonville, Fla. This office is under the supervision of C. L. Timmons.

Evans L. Shuff, 412 Title Building, Atlanta, will continue as Builders' "Industrial" representative and will handle the sale of Omega products for power plant and industrial applications in Georgia, Alabama, Florida and all of Tennessee.

John R. Purser Sales Engineers, Inc., of Charlotte, N. C., continues to handle Builders' line of flow meters, flow controllers, liquid level gages, etc., and now adds the Omega line of gravimetric and volumetric dry chemical feeders for all applications in North and South Carolina.

Two of the plants of the Van der Horst Corp. of America at Olean, N. Y., have been placed under the management of H. P. Munger. Before taking over his present responsibilities, Mr. Munger was superintendent of the new electro-tinning plant of Republic Steel at Niles, O. Mr. Munger joined Republic Steel in 1936 and became assistant chief metallurgist at the Warren, O., plant.

At the Bristol, R. I., plant of the United States Rubber Co. several promotions have been announced by W. A. Armstrong, factory manager. W. K. Priestley, formerly chief of process engineering, has been promoted to the position of development engineer; L. E. Dickinson, chief chemist to chief process engineer; W. H. Dibble, assistant chief chemist to chief chemist and J. F. S. Abbott to chief latex engineer in

For Metal Production

Production control is closely allied with temperature control in metal working and finishing operations. Even a variation of a few degrees can affect the quality, quantity, number of rejects, and of course, the over-all cost of the finished product.

Simple, inexpensive Sarco temperature controls are available for every steam and water operation in the plant. The degreasers, quenchers, and plating tanks shown above are held to precise temperatures regardless of loads, steam pressures, or the effect of the human element.

If the work itself adds heat to the job, an ingenious combination of Sarco electric controls will start cooling as soon as the desired temperature is exceeded.

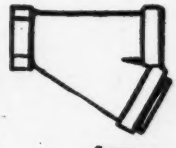
NOT COMPLICATED. Frequently a good steam trap is all you need, but many of the Sarco controls are just as simple, just as easy to install, and because of our many years of experience, just as reliable in operation.

Somewhere on this page we show a Sarco product that will improve your metal production. Somewhere in your vicinity there is a Sarco representative who can tell you how.

Sarco TR-40 Cooling Control

Sarco TR-21 Temperature Control

Sarco No. 87 Trap Control

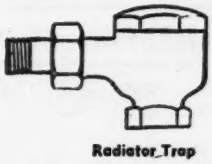

Sarco Strainer

AND THE RIGHT STEAM TRAP FOR EVERY APPLICATION

Thermostatic Steam Trap

Float-thermostatic Steam Trap

Inverted Bucket Trap


Radiator Trap

SARCO COMPANY, INC.
REPRESENTED IN PRINCIPAL CITIES
475 FIFTH AVE
NEW YORK 17, N.Y.

SARCO Saves Steam

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO

ASK FOR THE SARCO HOOK-UP BOOK

END CLOGGING WORRIES

ON COOLING TOWERS *and* CONDENSING UNITS *with* SOL-VET "08"

Find Out How This Water Treatment Formula Can Prevent Costly Scale and Slime in Your Equipment

● If scale, slime, rust, algae are clogging up the lines of your cooling towers, condensers and other heat exchanger equipment, it will pay you to look into the advantages of SOL-VET "08" service.

SOL-VET, highly recommended by leading engineers, offers you the facilities of one of the best equipped water laboratories in the United States. Thorough testing of your water can help determine the right SOL-VET "08" Cleaner that will prevent clogging—boost equipment capacity, save needless shutdowns for overhauling.

Let us help your plant insure its maximum contribution to war production through cleaner water, decreased maintenance. Write today for complete data on SOL-VET "08" with free analysis and recommendations for your specific problems of removing scale and dirt.

Remember that if you find SOL-VET "08" is not exactly as represented—when used according to instructions, and full accurate report is given within 30 days from date of purchase—your money will be refunded in full.

MAIL THIS COUPON FOR FREE ANALYSIS

ANDERSON-STOLZ CORP. — 1733 WALNUT ST.—KANSAS CITY, MO.

☐ Please send complete data on SOL-VET "08."

☐ We are forwarding water sample and mechanical data—please send analysis and recommendations.

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POSITION VACANT

Watch engineer for outstanding municipally owned electric generating plant. Applicants should be at least 38 years of age and have a high school education supplemented by study along mechanical engineering lines with at least five years' experience in field. In reply, please state age, experience, education, and general qualifications. Address Box 1437, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

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POWER PLANT ENGINEERING

53 W. Jackson Blvd.
Chicago 4, Illinois

As you know, the new Post Office zone delivery system has been adopted to expedite the mail. Simple in operation, its success depends on the cooperation of all mailers.

charge of latex development and control; F. S. Bartlett to assistant factory manager; T. C. Jannsen to production manager in charge of planning and manufacturing; A. E. Newton to general foreman of manufacturing departments and J. Waters to foreman of latex towers.

The Marley Co., cooling tower manufacturers with main offices in Kansas City, Kansas, announces personnel shifts resulting from raising their Houston office at 2006 Esperson Bldg. to the status of a divisional headquarters under the direction of Ray T. Jenkins who formerly headed the Tulsa division. The company is now represented in the Tulsa area (all of Oklahoma, western Arkansas and the Texas panhandle) by Walter S. Smith and his Process Equipment Co., 306 Tulsa Building. Mr. Smith, a resident of Tulsa for more than six years, is well-known throughout the territory as an applications engineer for heat transfer equipment. From the main office, Joe T. McKinley has joined the Houston staff. The Kansas and western Missouri area is now handled by R. H. Ahrens out of the company's headquarters at Fairfax and Marley Roads, Kansas City, Kansas.

Harold M. Miller has joined The Sheffler-Gross Co. as field engineer. He is a graduate of The Washington and Lee University, and has spent ten years with the Sinclair Refining Co. at Marcus Hook in connection with maintenance of instruments and controls. In recent years he has been with the Blaw-Knox Co. of Pittsburgh in connection with the synthetic rubber program where he was engaged in the design, supervision and installation of instruments and controls.

Allied Radio Corporation, 833 West Jackson Blvd., Chicago 7, Ill., is now publishing the *ALLIED Radio and Electric News,* a monthly bulletin of developments in the electronic field, distributed throughout the country to engineers, purchasing agents, department heads, etc., who are interested in the maintenance and development of electronic equipment. To be placed on the mailing list for this bulletin, address requests on your company letterhead.

Albert Ramond and Associates, Inc., is the firm name of an organization of engineers, formerly known as the Bedaux Co. The officers directing the activities of the organization are: Albert Ramond, president; J. C. Cramer, chief engineer; W. M. Fanning, vice president; L. S. Creason, district manager; M. E. Fuller, vice president; A. A. Dobson, vice president; E. D. Hayward, district manager; C. T. Dunn, vice president; J. C. Heiberger, vice president; C. W. English, vice president, and J. W. Roberts, vice president. Offices are established: New York 17, Chrysler Bldg; Chicago 11, Tribune Tower; San Francisco 4, Russ Bldg.; Toronto, Canada, 200 Bay St.

Albert Ramond and Associates, Inc., is managed by the group of executives who have directed the affairs of the company since 1937, and the field engineering staffs also remain intact.

The company will continue to provide a broad industrial engineering service embracing all phases of modern production management, including production control, cost and expense control, and wage plans.

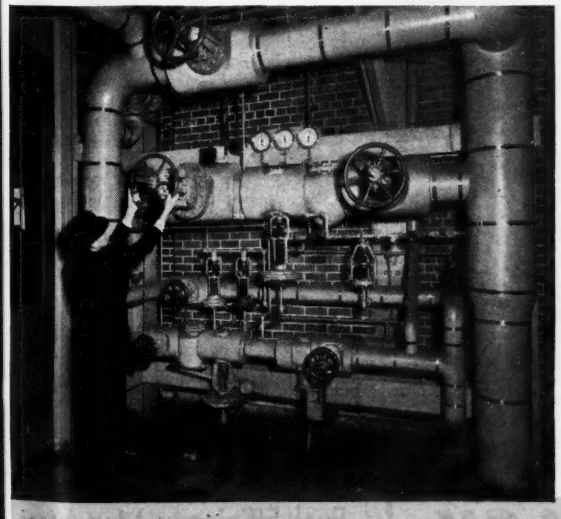
TO REDUCE DOWNTIME LOOK TO YOUR CONTROLS

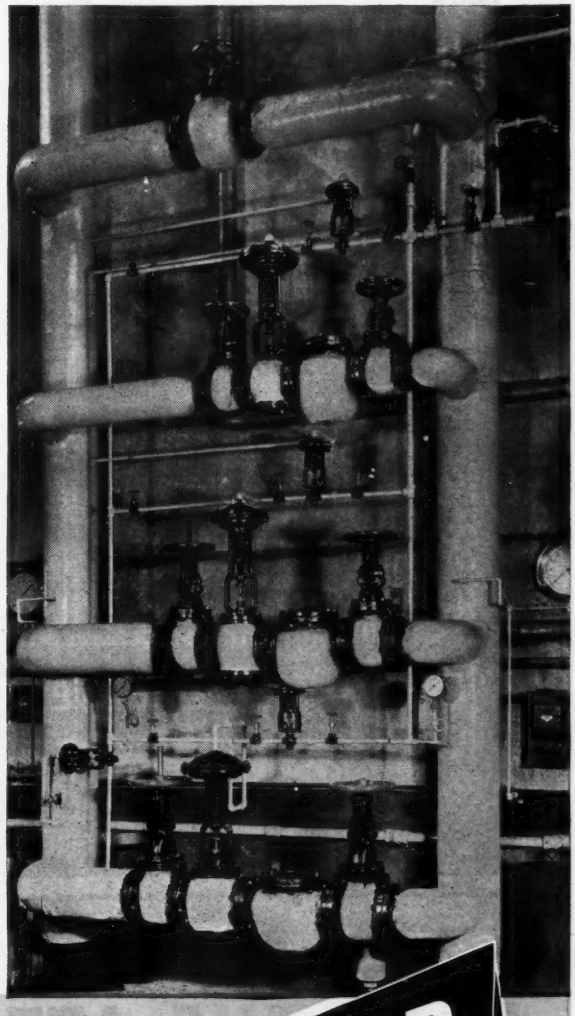
You're heading for trouble when maintenance costs begin to run high

MAKE SURE that controls are not the weak link in an otherwise efficient production set-up. Avoid the possibility of breakdown, by early replacement of controls that require excessive maintenance attention.

For *unfailing* regulation of pressure, temperature and flow, you can depend on McAlear Controls. Because every McAlear Control is individually developed for one job—and one set of operating conditions—precision engineered, metallurgically and mechanically, for long, trouble-free service.

One by one, as industry has conceived new processes, McAlear has developed advanced instruments for their control requirements. If *you* have a control problem, call on McAlear engineers. Draw on their fund of experience and readiness to help you. For informative bulletins and catalog, write McAlear Manufacturing Company, 1915 S. Western Avenue, Chicago 8.





Typical installations of McAlear pressure regulators used to maintain constant reduced steam pressures from power plants to heating service in large Government Housing Projects.

AVAILABLE SOON • AN IMPROVED DIAPHRAGM VALVE. New materials and radically improved design provide positive freedom from difficulties formerly encountered with diaphragm type valves. Unrestricted flow to full capacity of pipe line. Long-life, leak-proof shut-off surfaces. Completely dependable in service with highly corrosive fluids. Vastly superior where solids are held in suspension.

McALEAR
PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE
controls
for STEAM, WATER, AIR, OIL-GAS

DEPEND ON McALEAR AND YOU CAN DEPEND ON YOUR INSTALLATION

PLAY SAFE..
FIT ALL BOILERS WITH
SONDERGLASS
SINCE 1907
"The unbreakable gauge glass"
SONDERGLASS has been dipped in hot oil, 450 deg. F., then plunged into cold water without breaking. Also resists clouding and discoloration. Order it through your mill supply man or direct from us. We make a complete line of packings.
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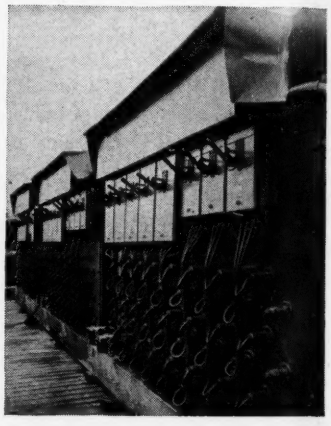
DISTRIBUTORS IN PRINCIPAL CITIES

BACK THE ATTACK
WITH WAR BONDS

NEWS FROM THE FIELD

Load Resistors for Testing Ship Generating Equipment

AUXILIARY generating equipment aboard newly launched ships at many shipyards is tested with the aid of immersion-type load resistors which absorb and dissipate the generating equipment energy during the testing period. The resistors consist of banks of General Electric heaters mounted in water tanks which when empty can be easily hoisted from the fitting-out pier to the ship and placed adjacent to the equipment.



Three load resistors showing manually operated switches and water emersion header terminals

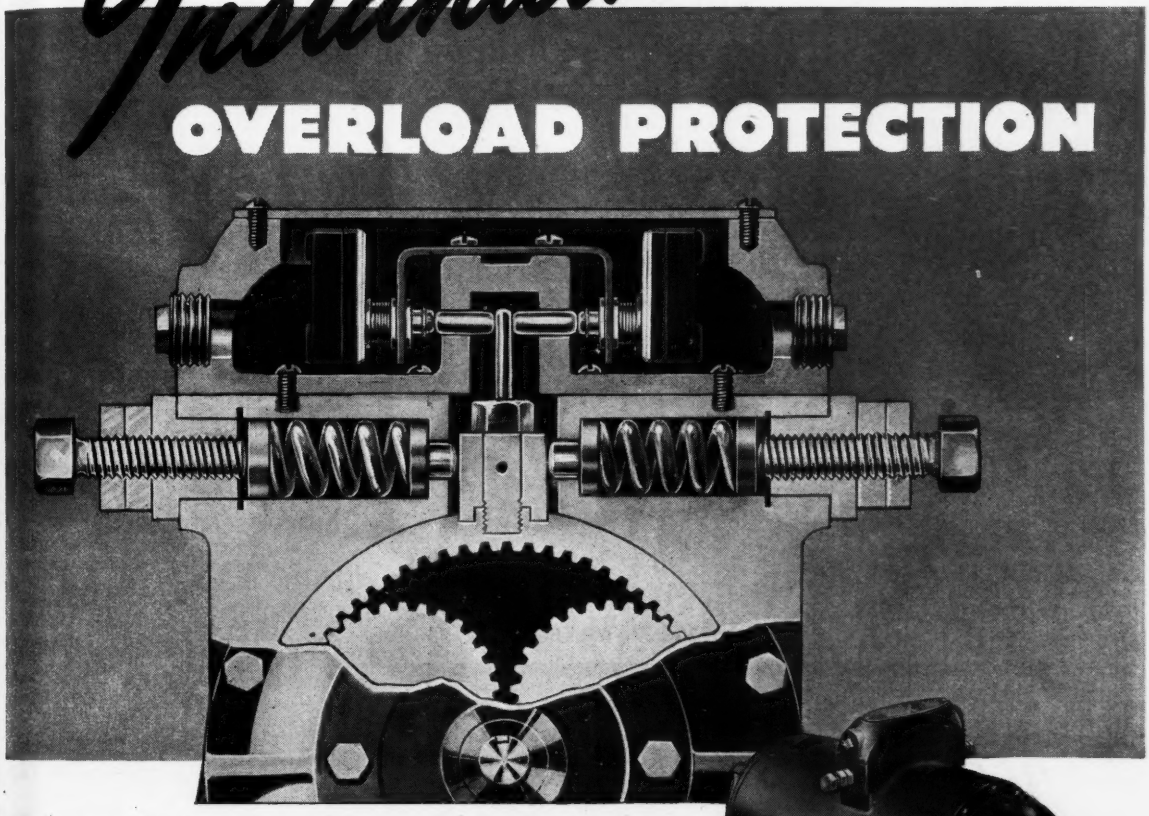
At the yard of the Seattle-Tacoma Shipbuilding Corp., Seattle, Wash., adequate pier space is not available for this operation, so new ships are anchored in the fitting-out basin and barge-mounted load resistors are floated out to the ships. Each barge has three screened-top water boxes, each mounting a bank of Calrod heaters. The heat resulting from the testing procedure is dissipated in the water.

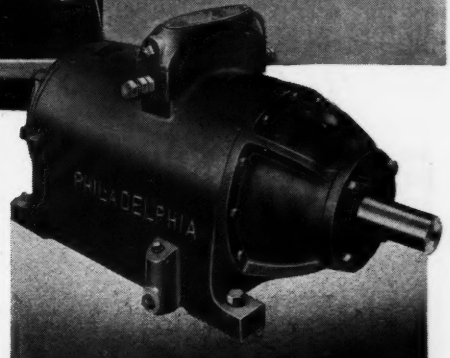
When the barge is alongside the ship, the resistors are connected to the ship's switchboard by long cables, and the generators brought up to normal full-rated voltage. Each of the barges carries three tanks. Two of them are for 440-v, 3-phase, Y or delta connections, each connection being for 348 kw in about 6-kw steps, by manual switching. These connections can be paralleled for loads even up to 696 kw. The third tank is for 120-v, single phase, and totals 93.5 kw in about 1.5-kw steps. The tanks may also be used for direct-current.

Fuel Efficiency Men Meet in Chicago

THE NATIONWIDE CAMPAIGN to save coal, fuel oil, heating gas and other fuels received additional impetus March 3 in Chicago when officials in charge of the national fuel efficiency program met to plan local campaign procedure. At the same time, Secretary of the Interior Harold L. Ickes in Washington announced the appointment of another district engineer and 12 area coordinators for the campaign which is being con-

Instantaneous
OVERLOAD PROTECTION





Responds to overloads more quickly than electrical thermal relays

The PlaneTorque is a feature that can be incorporated into any MotoReduceR—*the built-in motor and speed reducer*—to protect both the driven machinery and the drive unit from overloads.

By direct mechanical action of the overload, motor current is automatically and instantly cut off when a pre-determined limit is reached. This action is quicker than electrical thermal relays provide. With fuse protection the fuses must be selected to carry the starting current of the motor. Therefore the protection during the running period is not adequate.

The PlaneTorque can be cut out during the starting period merely by holding down the starting button but will become operative during the running period when the button is released.

To restart the PlaneTorque-MotoReduceR after overload cut-off only removal of the excessive load is necessary . . . a big time saving feature.

For applications such as stoker drives, conveyor drives, mixers, roll drives, etc. . . . investigate the PlaneTorque MotoReduceR. Get our Catalog M. R. 40 for further details.

Philadelphia
PLANETORQUE
MOTOREDUCER

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GEAR WORKS INCORPORATED
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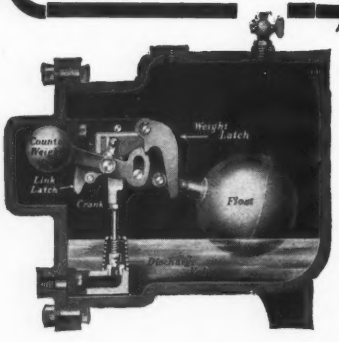
Industrial Gears and Speed Reducers
LimiTorque Valve Controls

NICHOLSON TRAPS ARE BEING USED BY

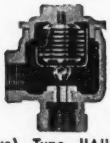
Representative Firms in Every Major Line of American Industry



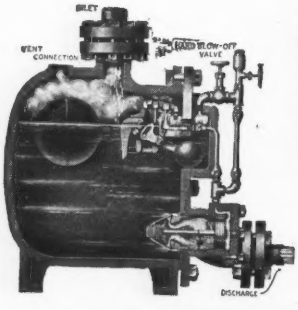
There's a Nicholson trap for almost every use—all with superior features.

(Left) Weight-Operated Steam Trap for pressures to 1500 lbs. at 1000-degree maximum temperature.

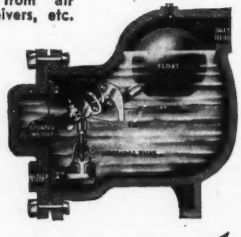
(Right) Compressed Air Trap for automatic drainage of water and oil from air tanks, receivers, etc.



(Above) Type "A" Thermostatic Trap, one of five types. Enormous water and air discharging capacity.



(Left) Piston-Operated Steam Trap. Positive, instantaneous, for pressures to 650 lbs. Non-wire drawing discharge valve. Valves, seats and working parts of stainless steel for trouble-free operation.



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W. H. NICHOLSON & CO.

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Use

ECLIPSE METAL HOSE

for
Low Cost Leakproof Handling of

OILS • GASES
CHEMICALS
REFRIGERANTS
AIR • STEAM
HYDRAULIC
VACUUM, ETC.
Also
DIESEL EXHAUSTS

ITS deep, parallel sidewall corrugations combine maximum flexibility with lasting toughness—makes Eclipse Flexible Metal Hose the logical low-cost material for Diesel exhausts and for handling all kinds of liquids or gases where vibration and expansion are present . . . Eclipse Metal Hose withstands high pressure and temperatures. Monel hose is stocked in sizes ¼ in. to 2 in. I.D.; steel hose can be produced up to 40 in. I.D. Write us about your problems of conveying non-solids, non-abrasives. Ask for latest descriptive bulletin.

THE INVISIBLE CREW
Precision Equipment by Bendix AVIATION CORPORATION
Dept. 19—Phila. Div.—Philadelphia, Pa.

ducted by volunteers from the industry in cooperation with the Bureau of Mines.

Nearly 40 men, including some of the nation's foremost authorities in the field of fuel utilization, had indicated they would be present at the Chicago round-table conference in the Sherman Hotel. They included members of the National Fuel Efficiency Council, city and area coordinators from many states, members of the coordinators' local executive or steering committees, and Bureau of Mines engineers.

The agenda called for discussion of the coordinators' initial steps in launching the program locally, procedures for regional engineers, and coordination with the Washington office. Thomas C. Cheasley, supervising engineer for the National Fuel Efficiency Section of the Bureau of Mines, Washington, was scheduled to make the introductory address.

Secretary Ickes said that Arlen Z. Jennings, senior fuel engineer of the Bureau of Mines, has been appointed district engineer by Dr. R. R. Sayers, Director of the Bureau, and assigned to Chicago, from where he will cooperate with area coordinators in Illinois, Wisconsin, upper Michigan, and part of Missouri. On February 1, John G. Mingle of the Bureau was assigned to Indianapolis, Ind., as district engineer for Ohio, Kentucky, Indiana, and lower Michigan.

The new coordinators, also named by Dr. Sayers, and their headquarter cities are W. D. Langtry, president of the Commercial Testing and Engineering Co., Chicago, Ill.; Parker A. Moe, chief operating engineer of the International Harvester Co., Milwaukee, Wis.; Irving E. Moultrop, Boston, Mass., area; Seelye Quackenbush, president of Quackenbush Co., Buffalo, N. Y.; W. F. Ryan, chief engineer of The Salina Supply Co., Salina, Kans.; R. F. Wood, executive director of Solid Fuel Institute, St. Louis, Mo.; Lyle E. Boyd, air conditioning supervisor of Caterpillar Military Engine Co., Decatur, Ill.; L. W. Crump, industrial sales manager of the Oklahoma Natural Gas Co., Tulsa, Okla.; Carl J. Eckhardt, head of mechanical engineering department, University of Texas, Austin, Tex.; and C. J. Gaskell, president of C. J. Gaskell Co., Memphis, Tenn. Two replacements also were announced, D. J. Howe, assistant to the coal manager of the Norfolk & Western Railroad Co., succeeding Fred K. Prosser as coordinator at Roanoke, Va., and James H. McKay, smoke control engineer for the city of Baltimore, Md., succeeding Edward L. Crosby at Baltimore. Prosser now is assistant deputy Solid Fuels Administrator, and Crosby remains active in the program.

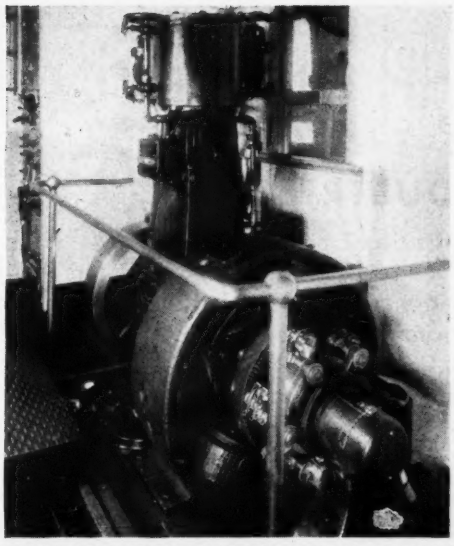
Power Plant Constructed by Delaware & Hudson

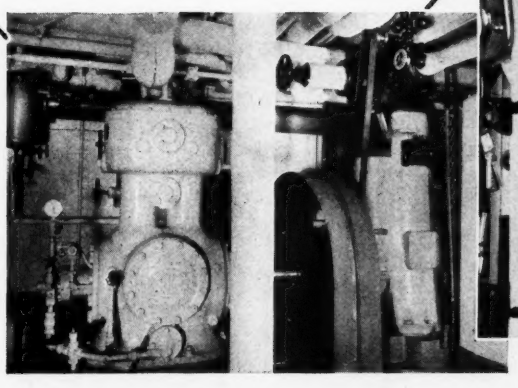
CONSTRUCTION of a $3,500,000 power plant by New York State Electric & Gas Co. is under way at Bainbridge, Delaware & Hudson Railroad officials announced today.

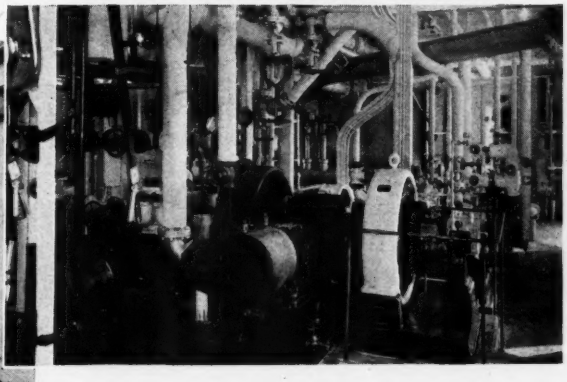
The new plant, one of the largest along the D. & H. lines, is being built because of war-time power needs in the industrial area from Oneonta to Binghamton.

B. D. Anthony, assistant general manager of D. & H., said the railroad would supervise installation of tracks at a cost of about $30,000, to be used primarily for transportation of coal to the plant.

20 MONTHS







That's the average "pay out" time for many Troy-Engberg Steam Engines

Not long ago, a complete study was made of some forty Troy-Engberg Engine installations. With *every* cost being considered and where costs with other forms of power could be compared, the records showed that these engines on the average "paid out" in 20 months. From there on, the greater part of the reduction in power costs became clear savings.

What the engine drives makes little difference. These forty odd engines are hooked up to such equipment as: stokers, pumps, compressors, fans, blowers, dryers and cookers. In nearly every case, the exhaust is used 100% for heating or processing.

This is By-Product Power and, under many conditions, it is *the lowest cost power obtainable.*

TROY ENGINE & MACHINE CO.

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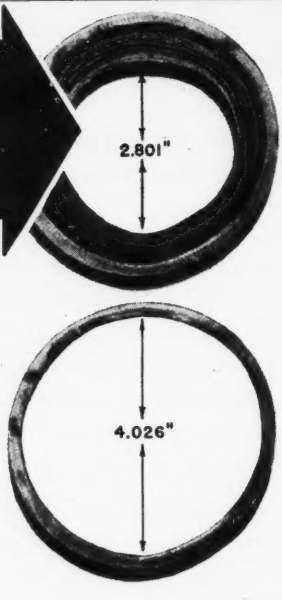
Pipe clogged by scale to HALF its efficiency



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REMOVE THIS SCALE AND MAINTAIN FULL CAPACITY FLOW . . .

Scaled pipes cost money.

Scale prevention pays dividends.

We will send you any of our technical publications. Better yet, a Haering Field Engineer will survey your plant and submit the story and the answer in writing.

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Deaerating Heaters for Victory Ships

THESE FIVE DEAERATING HEATERS are being shipped from Elliott Co., Jeannette, Pa., to the "U. S. Maritime Commission, Los Angeles." Destined for the new high-speed Victory ships, nearly 200 of these heaters are leaving the Elliott Co. plant at the rate of a carload a week.

Each heater weighs 4800 lb, is more than 11 ft high, and 5½ ft in diam. Each deaerating heater will handle a normal delivery capacity of 70,000 lb of water per hour through the ship's boilers, heating the water and removing dissolved corrosive gases which otherwise would pit the boiler tubes.

Arthur H. Kehoe Awarded Lamme Medal

THE 1943 LAMME MEDAL of the American Institute of Electrical Engineers has been awarded to Arthur H. Kehoe, vice-president of the Consolidated Edison Co. of New York, Inc., "for pioneer work in the development of alternating current networks and associated apparatus for power distribution."

It is expected that the medal and certificate will be presented to him at the Summer Technical Meeting of the Institute which is to be held in St. Louis, Mo., June 26-30, 1944. The Lamme Medal was founded as a result of a bequest of the late Benjamin G. Lamme, Chief Engineer of the Westinghouse Electric & Manufacturing Co., who died on July 8, 1924.

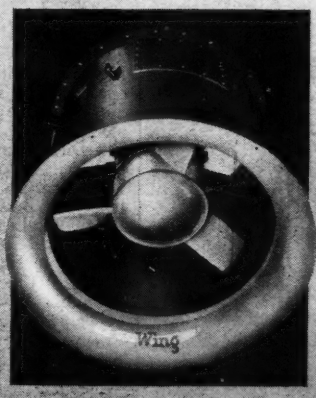
Arthur H. Kehoe has been vice-president in charge of construction and shops of the Consolidated Edison Co. of New York, Inc., since 1936. He is also a member of the Board of Directors of the New York and Queens Electric Light and Power Co., the New York Steam Corp., and the Consolidated Telegraph and Electrical Subway Co.

Mr. Kehoe was born in Bennington, Vt., on February 18, 1889. He graduated from Bennington High School and from the University of Vermont in 1911 with a degree of B.S. in electrical engineering. He was president of the New York Electrical Society from 1936 to 1938, vice-president of the New York Electrical Institute from 1933 until 1939, and also served as chairman of the Engineering National Section of the former National Electric Light Association.

Oil and Gas Power Conference

THE 17TH NATIONAL OIL AND GAS POWER CONFERENCE will be held May 8-10 at the Mayo Hotel, Tulsa, Okla., and will cover current problems of operation and design as well as recent developments that will influence the internal-combustion engines of the future. The tentative program includes: Present Status and Future Prospects of the Com-

"...and come out fighting!"



WING-AXIAL FLOW BLOWERS ON THE LST's MAKE IT POSSIBLE!

ONE BIG ADVANTAGE of the LST type of invasion landing is the fact that the tanks, jeeps, and motorized artillery can "come out fighting". There is no long suicidal wait for equipment to be lowered over the side of the ship and ferried ashore, no agonizing uncertainty while motors are started and gears shifted. No—the motors of the death-dealing mechanized equipment are started before the landing ship reaches shore. Numbers of Wing Axial Flow Blowers (each with a capacity of 35,000 CFM at 1 inch static pressure) suck the deadly gases out as fast as they are discharged from the exhaust pipes, keeping the air clean and wholesome in spite of the roaring engines. Then the ship beaches, the doors open and out come the fighting machines and swing into action.

L. J. Wing Mfg. Co.

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. . . Expediting Air Conditioning Maintenance Work

Slime is a frequently encountered air conditioning maintenance problem. Slime clings to pipes and other surfaces, impedes water flow, clogs spray nozzles, fittings and valves. That is why it will pay you to apply preventive measures by treating the recirculating water of your air conditioning or humidifying system with OAKITE AIREFINER.

You will find this specially designed material helps keep entire water circuit and cooling tower free from undesirable slime deposits and in addition, helps prevent corrosion of equipment surfaces. OAKITE AIREFINER is safe to handle and use . . . is extremely economical.

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Helpful manual also describes time-proven Oakite materials and techniques for removing impinged deposits from washable air filters, de-scaling watercooled and water-circulating equipment. Write for your FREE copy TODAY!

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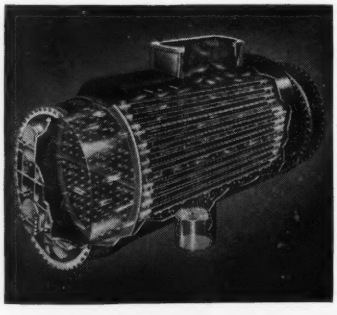
bustion-Gas Turbine, by S. A. Tucker, Associate Editor, Power; Recent Developments in Turbochargers, by C. F. Harms, Manager, Supercharger Department, Elliott Co.; Design Progress in Gas-Diesel Engines and Plants, by Robert Cramer, Asst. Chief Engineer, Nordberg Mfg. Co.; Designing Exhaust Systems for Best Engine Performance, by Ralph L. Leadbetter, Burgess-Manning Co.; Panel Discussion on Operation of Engines in Pipeline Service, led by J. G. Norton, Chief Mechanical Engineer, Magnolia Pipeline Co., and other leading pipeline engineers; Airline Maintenance, by R. A. Miller, Supt. of Overhaul, American Airlines, Inc.; Control for Aviation, Marine and Railroad Engines—papers by W. C. Trautman, Bendix Aviation Corp., M. A. Edwards, General Electric Co., and R. R. Stevens, Westinghouse Air Brake Co.; Analysis of Frequency Characteristics of Governors, Drives and Engine-Generating Sets, by W. E. Skinner, U. S. Engineers, North Atlantic Division and P. L. Giering; and Hydraulic Control Methods for Pipeline Engines, by J. R. Polston, Engineer, Stanolind Pipeline Co.

Surface Condenser Filmed

ALLIS-CHALMERS MFG. CO. has announced the release of a new movie, "The Surface Condenser," which shows the step-by-step production and operation of the modern surface condenser. The condenser's part in the steam cycle of a power plant is explained by diagram, cutaway view, and animation.



Shop scenes show the entire construction of the condenser. How engineering of each part of the surface condenser contributes to its total efficiency in reclaiming the steam exhausted by the turbine is demonstrated. Finally, the audience sees an animation of the condenser in operation and then an animated diagram of the complete power plant system of which the condenser is a necessary part. Running time of the condenser film alone is 18 minutes, which, when the film is used in conjunction with Allis-Chalmers' "The Magic of Steam," makes a full 40-minute program on turbines and condensers. It is a 16 mm film, for use on sound projectors only.

The movie is being loaned free to any industry or power group interested in showing it, particularly in connection with training programs.

Revisions Announced by American Standards Association

REVISIONS OF AMERICAN WAR STANDARDS for electrical panel-type instruments and shunts have been announced by The American Standards Association. These revisions have been made as the result of field experience, and the stand-

Enco OIL BURNERS

have these

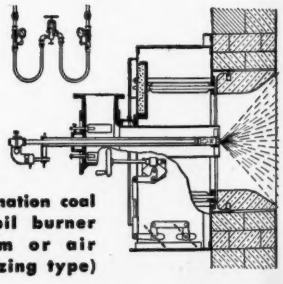
7 ADVANTAGES

in pulverized coal fired boilers . . .

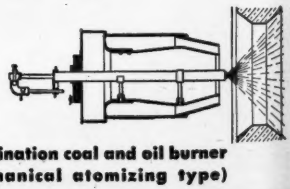
They may be installed in practically all types of pulverized coal burners, with these seven important advantages:

- **They warm up cold furnaces**
- **They ignite pulverized coal—safely**
- **They assure continuous operation in case coal system fails**
- **They provide efficient and safe operation on bank and at low loads**
- **They respond almost instantly to sudden load changes**
- **They permit operation with oil or coal—whichever is available and lowest in cost per BTU.**
- **All capacities of steam, air or mechanical-atomizing types are interchangeable**

The foregoing are only a few of the reasons why Enco oil-burners have been bought by a long list of leading industrial firms. Details of how Enco oil-burners can be adapted to your present pulverized coal burners will be gladly supplied—without obligation. Write The Engineer Company, 75 West St., New York, N. Y.



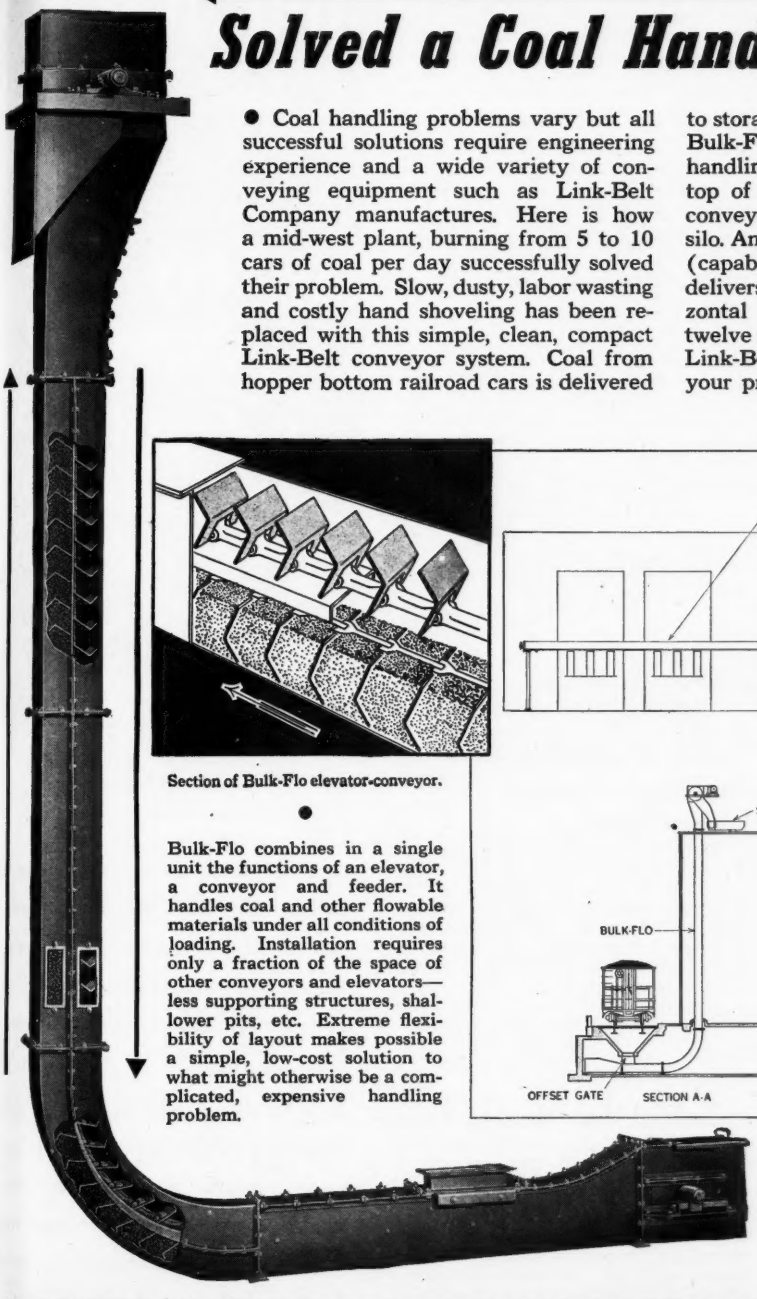
Combination coal and oil burner (Steam or air atomizing type)



Combination coal and oil burner (Mechanical atomizing type)

Enco Burners

How a Small Steam Plant Solved a Coal Handling Problem

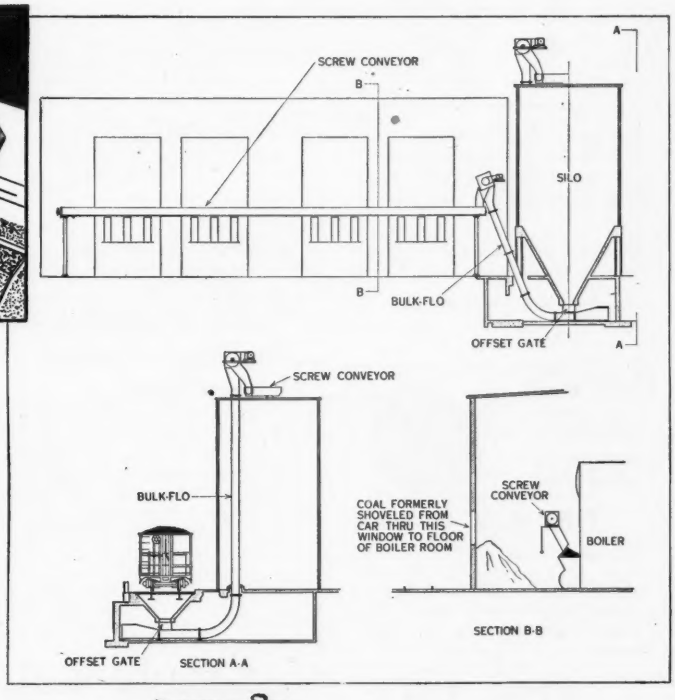


● Coal handling problems vary but all successful solutions require engineering experience and a wide variety of conveying equipment such as Link-Belt Company manufactures. Here is how a mid-west plant, burning from 5 to 10 cars of coal per day successfully solved their problem. Slow, dusty, labor wasting and costly hand shoveling has been replaced with this simple, clean, compact Link-Belt conveyor system. Coal from hopper bottom railroad cars is delivered to storage silo (200-ton capacity) with a Bulk-Flo elevator-conveyor (capable of handling 30 tons of coal per hour). On top of silo is a short horizontal screw conveyor discharging coal to center of silo. Another Bulk-Flo elevator-conveyor (capable of handling 15 tons per hour) delivers the coal from the silo to a horizontal screw conveyor which feeds all twelve stoker hoppers of the four boilers. Link-Belt is prepared to help you solve your problems. Send for Catalogs.

Section of Bulk-Flo elevator-conveyor.

●

Bulk-Flo combines in a single unit the functions of an elevator, a conveyor and feeder. It handles coal and other flowable materials under all conditions of loading. Installation requires only a fraction of the space of other conveyors and elevators—less supporting structures, shallower pits, etc. Extreme flexibility of layout makes possible a simple, low-cost solution to what might otherwise be a complicated, expensive handling problem.



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CONVEYORS·ELEVATORS·SKIP HOISTS·CRUSHERS·LARRIES·STOKERS

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ENGINE *ALARM* SYSTEMS

TYPE M

CONTACT MAKERS

Pressurestatic or Thermostatic Contact Makers for lubricating-oil or circulating-water systems for all types of stationary or mobile equipment.

Now available in sheet-steel housing to avoid critical materials.

Can be supplied with complete indicating system.

COMPLETE ALARM SYSTEM

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Complete alarm system consists of Type M-3B combination pressure control, junction box and visual indicator, together with Type M Thermostatic Contact Maker, and signal howler.

WATER- AND WEATHER-TIGHT

TYPE C

CONTACT MAKERS

Where Contact Maker is exposed or must be waterproof, Type C Pressurestatic or Thermostatic is recommended.

Manufacturers of engine alarm systems, annunciators, marine and industrial instruments. Write for specifications.

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ards provide for complete interchangeability, both electrically and mechanically, while leaving the manufacturer free to use his ingenuity in design of the insides and to introduce improvements. They cover performance requirements, test methods, standard dimensions and ranges for a standard series of the instruments mentioned which will meet the quality demanded by the armed forces. Both standards include applicable specifications and drawings, classification, materials, and workmanship general and detail requirements applicable to individual government departments. There are copious notes and drawings which further clarify the texts.

Rolph Elected President of Ohio Engineers

THE OHIO SOCIETY OF PROFESSIONAL ENGINEERS has elected T. W. Rolph to be its president. Mr. Rolph is a member of the Illuminating Engineering Society, an associate member of the Optical Society of America, vice president of the Holophane Co. and is president of the Newark, Ohio, Rotary club.

He has been a frequent contributor to the technical press. Several years ago, he consulted with leading lighting engineers in England and on the continent in connection with his illuminating engineering work. In 1940 he was awarded a plaque by the National Association of Manufacturers, naming him a "Modern Pioneer on the frontier of American Industry," in recognition of distinguished achievement in the field of science and invention, which advanced the American standard of living.

Westinghouse Sets Machine Tool Electrification Forum Dates

MANY OF THE PROBLEMS facing machine tool manufacturers and users today and in the future will be discussed by recognized experts during the two day session of the 1944 Westinghouse Machine Tool Electrification Forum to be held at the William Penn Hotel, Pittsburgh, on May 1st and 2nd. The Forum is planned to provide an opportunity for machine tool engineers and executives of machine tool builders to discuss electrical problems relating to design and function of machine tools.

Industrial Unit Heater Assn. Elects Officers

AT THE EIGHTEENTH ANNUAL MEETING of the Industrial Unit Heater Association held in Chicago, Ill., on March 2, 1944, the following officers were elected for the ensuing year: N. Downey, president; C. E. Scott, vice president; and L. O. Monroe, secretary-treasurer.

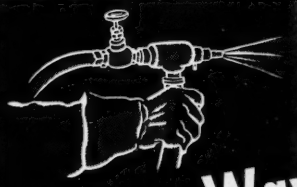
Boilers for Victory Ships

FOR THE NEW Victory Ships, the Maritime Commission has selected boilers of the single-pass, sectional header type, which was originated and introduced by Babcock & Wilcox Co.

A large percentage of these new vessels are being equipped with boilers manufactured by B&W; there are two boilers per ship. Each unit includes B&W oil burners, water-cooled side walls, interdeck superheater, and a Babcock & Wilcox stud-tube economizer.

The efficiency of these units will be better than 87 per cent at full power op-

BRICKSEAL



An Easy Way to Conserve Refractories

1—*Paint or spray brickwork with BRICKSEAL.*

2—*Light fire. Boiler is ready for instant use.*

Heat of fire-box vitrifies Brickseal permanently into all refractory pores, cracks and joints, forming a highly-glazed, monolithic coating, impervious to slagging, clinkering, corrosive gases, flame abrasion and air infiltration.

Brickseal will not crack or peel off due to sudden temperature changes, because it remains semi-plastic until the furnace cools. Brickseal prolongs the life of new or old refractories for a fraction of the cost of relining.

Write for Brickseal sample or representative, today.

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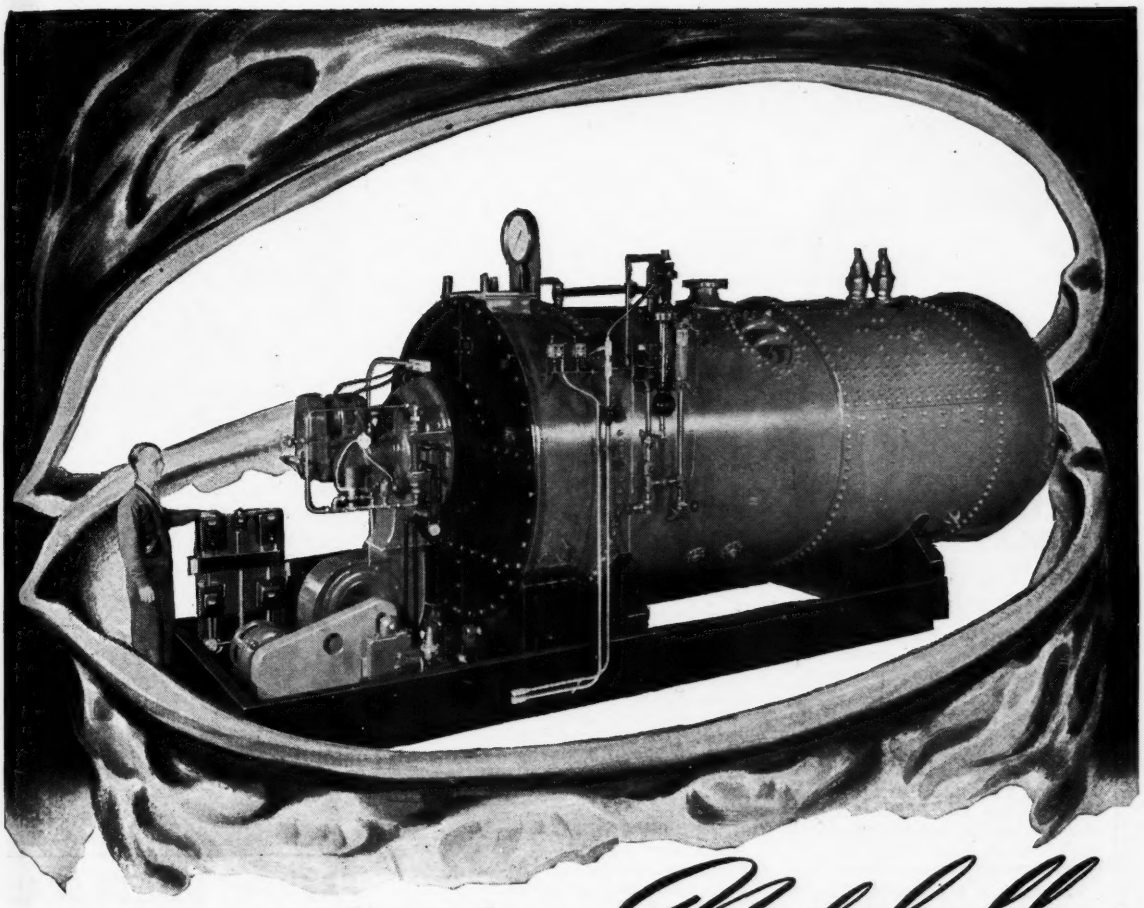


A Steam Plant in a *Nutshell*

"THERE it is in a nutshell". . . the most compact means for generating steam for heat, power, or processing . . . the Cleaver-Brooks steam generator.

These self-contained steam units are shipped in complete "packaged" form ready to set down on the floor and connect to water, oil, and steam lines. Hundreds of American manufacturers have found it a simple, inexpensive job of installation requiring minimum floor space and room.

Cleanliness in operation is an outstanding feature of the Cleaver-Brooks steam generator. There is no ash, dirt, soot or smoke. The generator runs with almost no attention other than simple routine checking and maintenance.

It is no less astonishing that, in addition to all these advantages of a complete "packaged" unit with minimum space requirements and cleanliness of operation, the Cleaver-Brooks steam generator sets a new high in fuel economy.

The four-pass, fire tube design insures getting the last possible heat unit out of every ounce of fuel. (Thermal efficiency of better than 80% guaranteed.) Steam comes fast and in large volume for the size of the generator — flexible firing rate responds quickly to sudden steam demands assuring a steady pressure throughout the connected system.

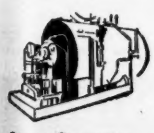
In a nutshell, Cleaver-Brooks steam generators give low cost steam with the least demand on the plant operating force for installation, operation, or maintenance. Sizes run from 15 to 500 bhp., at steam pressures from 15 to 200 lbs. sq. in.

CLEAVER-BROOKS COMPANY
5136 N. 33rd STREET MILWAUKEE 9, WIS.

INSTANT STEAM—COST CALCULATOR
Write for this instant steam cost calculator. Yours for the asking. Figures steam costs for oil or coal.

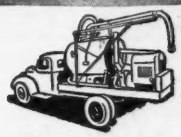
Cleaver-Brooks
STEAM GENERATORS

CLEAVER-BROOKS PRODUCTS INCLUDE:


Steam Generators

Food Processing Equipment

Tank Car Heaters


Bituminous Boosters

Special Military Equipment

Install FRANCE Metal Packing for "'Round-the-Clock" Production

The renewal of ordinary packing every few weeks or months increases horsepower and production costs.

Minimum friction is encountered with France Metal "Ring of Distinction" Packing. No undue force can be exerted on rods or stems by tightening the stuffing box stud nuts. The rings are free to float in the case that retains them and are held to the rod or stem with a garter spring having minimum tension.

The result is tight "full-floating", trouble-free performance for years. Prompt delivery assured.

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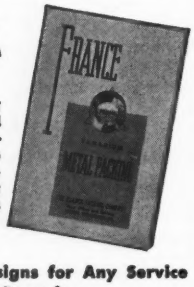
44-page Catalog of useful and valuable information. Write for your free copy of Catalog M-5, with facts on



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Request France Engineers to analyze your packing requirements. There is a representative close at hand.

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Original **FRANCE METAL PACKING**

eration, when evaporating 37,500 lb of steam per boiler per hour at 465 psi working pressure, and 750 total steam temperature at the superheater outlet, with feedwater temperature of 240 F at the economizer inlet. The boilers are designed for operation at 150 per cent of full power capacity.

The boilers described above are being installed in AP-3 vessels. Similar units, of somewhat smaller capacity, are being installed in other Victory Ships, the normal capacity being 26,500 lb of steam per boiler per hour.

New Directory of Association of Consulting Chemists and Chemical Engineers

THE REVISED and enlarged eighth edition classified directory of the Association of Consulting Chemists and Chemical Engineers, 50 E. 41st St., New York 17, N. Y., has just been issued and is available for the asking. The book contains 96 pages of information and guidance regarding the specialized services of members of the Association, and a complete list of members and their classifications.

Refrigerating Engineers to Meet in Pittsburgh

THE AMERICAN SOCIETY OF REFRIGERATING ENGINEERS through its president, A. B. Stickney, has announced that the 31st Spring Meeting will be held June 5-6-7, 1944, in the William Penn Hotel in Pittsburgh, Pa. Hosts for this large gathering of refrigeration and air conditioning men will be members of the Pittsburgh Section of the ASRE, under E. L. Scanlon, Section Chairman. Other members of the convention executive committee for the local group are F. K. Stiening, G. O. Weddell and J. S. Forbes. Emphasis in the technical sessions will be on current developments in the design and application of refrigeration equipment, according to Clifford F. Holske, chairman of the Society's Program Committee.

Post-War Cable Trends

IN A PAPER on the "Future Trends in Cables for Distribution Voltages" at a meeting of the E.E.I. Transmission and Distribution Committee, February 15, at Cincinnati, G. B. Shanklin, engineer of General Electric cable division, predicted improved durability and quality for distribution cable, with rubber or rubber-like insulation.

"The main insulation will consist of natural or synthetic rubber, dependent upon post-war availability and cost of raw materials," he said. "Protective coverings will be required, as in the past, either metallic or nonmetallic. There will be no radical changes in operating voltage or temperature limits, possibly some increases but nothing radical."

Mr. Shanklin stated that "improved durability may extend the use of nonmetallic underground distribution cable, particularly low-voltage network cable, but lead sheaths for such cable will by no means be dispensed with."

In discussing types of cable, Mr. Shanklin said that a trend toward increased use of gas-filled cable for primary distribution feeders is plainly indicated, especially those high-voltage primary feeders where continuity of service is important.

"During the past five years more than a quarter million feet of gas-filled

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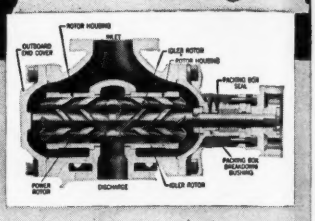

The De Laval-IMO rotary displacement pump for fuel and lubricating oils has only one stuffing box. It has been designed with the operator's problems in mind. Ease of packing is only one of the important and exclusive features.

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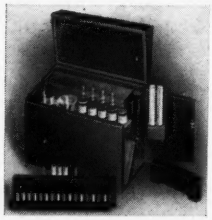

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HELPFUL BULLETINS

Practical answers to many wartime problems of plant operation and maintenance are found in the engineering bulletins offered by manufacturers. For your convenience we publish the following summary of helpful literature available. To obtain copies of the bulletins and catalogs described, simply indicate the paragraph numbers on coupon on next page, detach and mail.

BOILER PLANT EQUIPMENT

1 **S-A Type Boilers**—Bulletin B-41-3 gives helpful data on S-A boiler units for either stoker firing or oil burning. Wide range superheat control and other features of these units are described in detail and cross sectional views show typical installations. Foster Wheeler Corp.

2 **Uni-Flo Coal Conveyor**—Bulletin No. 442 describes the Rex Uni-Flo conveyor for coal and other free flowing bulk materials. Composed of a chain belt equipped, closely spaced scraper carrier flight, this unit is self-feeding, self-cleaning, conveys horizontally, vertically or at any angle. Bulletin contains arrangement diagrams, capacity tables, horsepower formulas and other helpful data. Chain Belt Co.

3 **Steam Plant Data** — "Dividends from Your Power Plant" is the title of an interesting booklet, telling in non-technical language what engineers and plant managers ought to know about steam generation and boiler efficiency. Preferred Utilities Co.

4 **Heavy-Duty Stokers**—20 pg bulletin features Iron Fireman Powderam heavy-duty stokers for boilers developing up to 400 hp; outlines features of these stokers, shows actual installation photographs and lists representative users. Iron Fireman Mfg. Co.

5 **Boiler Girth Seam Protector**—Bulletin describes the National girth seam protector to prevent leaking and fire-cracking on old or new seams. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. National Boiler Protector Co.

6 **Radiant Heat Boiler**—Quick steaming, high ratings, water wall operating economy, moderate height, adaptability to any fuel, are among features of Edge Moor radiant heat boiler described in new Catalog 102. Edge Moor Iron Works, Inc.

7 **Practical Hints On Fuel Saving**—New 4 pg Reference Bulletin No. 4 contains a simple analysis of heat losses and suggestions for improving the efficiency of boiler units. Also shows interesting example of spreader stoker firing equipment designed to give wide latitude in coal selection for an eastern industrial plant. Coal Bureau, Upper Monongahela Valley Assoc.

8 **Fuel Oil Purifier** — Attractively illustrated 8-pg Bulletin 65 shows operating features and typical applications of Honan-Crane fuel oil purifier. Also contains U. S. and metric weights and measures and other useful engineering data. Honan-Crane Corp.

ELECTRICAL

9 **Free Fluorescent Handbook**—How to test fluorescent lamps and starters, how to make a simple test board, and many other practical hints are given in the new book, "Timely Wartime Tips on Fluorescent Maintenance." A valuable reference for operating engineers and maintenance men. Free. Sylvania Electric Products, Inc.

10 **Insulator Data Book**—A revised catalog of Pinco standard insulators and fittings has just been issued. It shows units which can be supplied under Schedule V, WPB Limitation Order L-154 of June 29th, 1943. Valuable tables are included, giving Suspension String Data; Stacking Unit Data for Switch and Bus Units; Bare Wire Tables for use in reference to all classifications of Pinco clamps listed. Porcelain Insulator Corp.

11 **Pyranol Capacitors** — How to increase circuit capacity without extensive re-wiring is explained in Pyranol Bulletin GEA-77. Pyranol capacitors are readily available—easy to install. They are said to represent today's quickest method of improving power factor. General Electric Co.

12 **Fast-Drying Insulating Varnish**—"Speedairbonds," a group of air-drying, insulating varnishes, designed for use in the manufacture and repair of electrical equipment, are described in new Bulletin 243. The manufacturer claims Speedairbonds dry exceptionally fast to a smooth, glossy finish—are oil-proof and extremely water, acid, and alkali resistant—possess highest dielectric qualities—assure flexibility and long life. Bulletin also tells about Stilway stripping compound, balancing compound, rust preventatives, commutator paints, Identifiers, etc. The Sterling Varnish Co.

13 **Insulation Tester**—The new U.S.-made "Megger" insulation tester, in plastic molded case, and said to have the same ruggedness and accuracy common to all "Megger" instruments, is described in new Bulletin 1735-PE. James G. Biddle Co.

14 **Electrical Equipment**—Set of free bulletins furnishes data on the Burke line of elctrical equipment which includes a-c synchronous generators for Diesels; a-c and direct current generators; 1 to 1500 hp induction motors; motor generator sets; a-c synchronous motors for compressors; terminal blocks. Burke Electric Co.

15 **Motors Maintenance** —"A Guide to Wartime Care of Electric Motors" is a useful handbook on the maintenance problem of motors under hard service and unfavorable conditions. It is applicable to all types of motors and tells the cause and correction of troubles due to dirt, oil, moisture, vibration, misalinement, wear and overload. A check list of symptoms you can see, hear and feel serves as a diagnosis chart. Allis-Chalmers Mfg. Co.

FANS, PUMPS AND COMPRESSORS

16 **Centrifugal Pumps**—Bulletin 5810D describes a complete "family" of single-stage, split-case pumps for low, moderate, medium, and high heads. A useful reference for all operating engineers. Fairbanks, Morse & Co.

17 **Time-Saving Compressor Calculator** —An ingenious compressor calculator, designed to save time in computing compressor requirements or in estimating the performance of present compressor units has been prepared by The Cooper-Bessemer Corp. The calculator is pocket size, of slide rule design; can be used for quickly estimating the volumetric efficiency, brake horsepower and total piston displacement of any make of compressor.

18 **Pumping Hand Book**—New Westco Industrial Pumps Catalog No. 43 gives specifications and performance data on pumps for boiler feed, brine circulation, condensate and many other jobs. Contains units of measurement, heads and pressure equivalents and other handbook information. Joshua Hendy Iron Works, Pomona Pump Div.

19 **Rotary Pump Facts**—Bulletin 304, "Facts About Rotary Pumps" contains much of the basic data needed for selecting pumps to handle liquids of various types. Charts, reference tables, sectional views of bearings and gears, etc., are a few of the contents given. Blackmer Pump Co.

20 **Controllable Capacity Pumps**—Bulletin 65 gives full details, sizes and ratings of Aldrich-Groff pumps which provide for automatic or remote manual control of delivery, from zero to capacity, at constant pump speed. The Aldrich Pump Co.

INSTRUMENTS AND CONTROLS

21 **Meters and Control Systems**—For an outline of the many ways in which Bailey meters serve the modern steam plant, send for copy of Bulletin 15-B. Company engineering service covers application, design, construction, calibration, installation and adjustment of equipment necessary to secure desired improvements. Bailey Meter Co.

22 **Universal Rotameter**—New bulletin covers improved appearance, greater flexibility of installation, easier maintenance of SK Universal Rotameter—a simple, low-cost instrument which accurately indicates rate of flow of a liquid or gas in a pipe line. New type end-casting allows for 25 different piping hookups. Schutte & Koerting Co.

23 **Temperature and Humidity Controls** — A complete line of self-operating and air operated controls for accurate and dependable automatic temperature and humidity control for industrial processes, heating or air conditioning systems is described in circular 2520. The Powers Regulator Co.

24 **Control Valves for Air and Gas**—Attractive Catalog No. 406 describes Rockwell slide valves and butterfly valves for control of air, gas, liquids. Contains sectional views of different types, suggested applications, dimension tables and other useful data. W. S. Rockwell Co.

25 **All-Electric Liquid Control**—28-pg Catalog No. 943 which features their all-electric floatless liquid level

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control has just been released by the B/W Controller Corp. In addition to describing the primary equipment such as electrodes, relays, etc., required for the installation of an all-electric level control, there are included special controls and panels, a-c automatic starter and relay combinations, selector switches, special relays, waterproof enclosures, wiring diagrams, etc.

26 **New Duragauge Bulletin**—Ashcroft announces a new 12-pg bulletin on the phenol turret case Duragauge. Full explanation in text and illustration is given of the rotary movement, the design and construction of the system, general dimensional drawings, illustrations of all thirty-one dials available. Manning, Maxwell & Moore, Inc.

26A **Thermometers and Controls**—New 48-pg Trerice Catalog No. 101-G covers construction features and applications of industrial thermometers, recording thermometers and gauges, air-operated controllers and other instruments. Contains sectional views, installation diagrams and helpful data. H. O. Trerice Co.

MECHANICAL TRANSMISSION

27 **Unlimited Variable Speed Drive**—Every speed to zero, forward and reverse, without stopping motor; full torque over entire speed range; close speed adjustment with accurate return to pre-set speeds—are advantages claimed for Graham variable speed drive as described in Bulletin 506. Graham Transmissions, Inc.

28 **Wire Grommet V-Belt**—A 4-pg folder on its line of V-belts, featuring information about its recently announced wire grommet type, has just been published by The B. F. Goodrich Co. Twin cores of endless steel wire twisted on itself form the grommets, which are kept at a uniform distance from the sides of the belt throughout its length. The grommets are covered with counter-balancing and insulated cord. Wire grommet V-belts are built with exceedingly high tensile strength, high resiliency to resist shock, and assure but little permanent stretch.

29 **Gear Lubrication Data**—Gear lubrication problems and their correct handling are described in a new booklet issued by E. F. Houghton & Co. Various types of gears are described and illustrated, together with the proper types of lubricants for gear sets, head-stocks, open gears and worm gears. General instructions on proper lubrication maintenance are also included.

30 **Bearing Metals**—8-pg bulletin gives many helpful hints on how to keep bearings on the job and shows what bearing metal to use for every application. A useful reference for operating and maintenance men. Magnolia Metal Co.

PIPING, VALVES AND FITTINGS

31 **Where to Use Valves, Drains, and By-Passes**—Thirty-two pages of helpful information tells you which valves to use, differences among the various types of valves, the fundamentals of valve designs and application. Jenkin Bros.

32 **Blow-Off Valves**—A line of blow-off valves designed to meet all draining and blow-down requirements is described in new catalog; section B-431 for pressures up to 2500 lb; section B-422 for lower pressures. Many charts on physical properties, dimensions and other useful data are included. Yarnall-Waring Co.

33 **Welding Fittings**—Bulletin WF-41 gives complete and interesting information on welding fittings (ells, tees, flanges, nipples, return bends, etc.) that improve design and reduce cost of piping systems. New fittings of this company not previously available are described. New American Standard for butt welding fittings is also listed. Midwest Piping & Supply Co., Inc.

34 **Seamless Flexible Metal Hose**—Bulletin H 201-935 furnishes engineers complete data covering the physical properties and other pertinent information. Generously supplied with illustrations and diagrams, it is invaluable to engineer, designer, and specification man. Eclipse Aviation Seamless Flexible Metal Hose, Philadelphia Div. of Bendix Aviation Corp.

35 **Expansible Remote Control Valve**—New Bulletin No. 800 outlines the design and operating advantages of the Grove Flexflo remote control valve. Flexive molded composition rubber tube is only moving part; is said to withstand severe abrasive wear and corrosion. Bulletin contains many control diagrams, flow capacity charts, etc. Grove Regulator Co.

36 **Steam Trap Handbook**—Tables, charts, diagrams and rules for selecting traps, giving complete explanations, make the new 36-pg Armstrong Steam Trap Book a handy reference volume for every engineer's library. Armstrong Machine Works.

37 **Bronze and Iron Valves**—Catalog No. 42 describes the design and application of Fairbanks bronze and iron valves in types and sizes for virtually every service. Said to deliver long service at low cost. The Fairbanks Co.

38 **Reducing Valves and Strainers**—Catalog 154 describes direct pilot-operated super-sensitive and semi-balanced type valves of semi- and cast-steel construction. Quick cleaning strainers of semi-steel and forged steel—modern designs of well established products. The Strong, Carlisle & Hammond Co.

PRIME MOVERS

39 **Mechanical Drive Turbines**—A series of bulletins describe the complete Terry line of mechanical drive turbines. Bulletin SR-114 covers the Multi-stage turbine; Bulletin S-107 describes the Axial Flow Impulse turbine; Bulletins S-116 and S-99 describe the Solid Wheel turbine. The Terry Steam Turbine Co.

40 **Heat Recovery Silencers**—Loss of engine efficiency, excessive back pressure, unnecessarily noisy operation, can often be traced directly to improper exhaust piping. Maxim heat recovery silencers convert waste exhaust heat into steam or hot water for industrial processing operations or for heating. Write for Bulletins WH-100, WH-102 and WH-103. The Maxim Silencer Co.

41 **Diesel Operation**—"Diesel Operation—Fuel and Lubricants" is the title of an 80-pg catalog of charts, diagrams, illustrations and text aids for Diesel engineers and executives in meeting lubrication problems. The Texas Co.

42 **Piston Ring Data**—An 8-pg reprint of a technical paper entitled "The Vibration Characteristics of 'Free-Free' Circularly Curved Bars" is being offered by The Cooper-Bessemer Corp., Diesel engine, gas engine and compressor builders. Taken from a recent issue of the publication, "Journal of Applied Physics," the material was prepared and written under the direction of W. A. Pliskin and J. E. Edwards of Ohio University, and F. P. Bundy, Harvard University, with the collaboration of engineering officials of The Cooper-Bessemer Corp.

WATER TREATMENT

43 **Carbonaceous Zeolite Softeners**—Publication 4021 tells how the Cochrane Carbite softener helps maintain boiler water both sludge-free and low in alkalinity. Contains sectional drawings of Carbite system, chart showing relation between carbon dioxide, total alkalinity and pH value and other helpful data. Cochrane Corp.

44 **Zeolite Water Softeners**—New 16-pg Bulletin No. 603 describes zeolite water softeners and other water conditioning equipment. Includes a detailed description of newest type Elgin "Double Check" zeolite softener which is said gives up to 44 per cent more capacity, prevents zeolite loss, cuts backwash and rinse water requirements and reduces salt consumption. Bulletin also tells how to increase capacity and efficiency of existing zeolite softeners. Other subjects covered are iron removal, filtration, aeration and boiler water conditioning. Elgin Softener Corp.

44A **Water Clarification**—Bulletin 29 furnishes data on the use of Nalco No. 41 in the clarification of water, through pressure filters, for beverages, cooking or process work, swimming pools, ice plants, etc.; also in oil removal filters. National Aluminate Corp.

45 **Sure-Shift Interconnector**—Bulletin describes the new Sure-Shift interconnector which makes standby water supply immediately available without possibility of contamination. Requires only 3 pipe connections; has been inspected by New York State Department of Public Health. Industrial Interconnector Co.

46 **Water Conditioning System**—New bulletin describes the technical water conditioning system which provides individual formulas to fit every water type. Said to provide a special balance of water properties that overcome scale, foaming, pitting, corrosion, caustic embrittlement. Water Treatment Co. of America.

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MISCELLANEOUS

47 Fire Protection Hints — Latest issue of High Pressure, a bulletin issued by Walter Kidde & Co., describes carbon dioxide method of licking fires in manholes, aboard ship, etc. Contains suggestions for lessening fire hazards around oil supply lines, and cross reference to previous articles on specific applications of protective equipment.

48 Lubrication Wall Chart — Now available to all engineers and operating executives is the new Sun Save-and-Serve Lubrication Program. It includes the following printed pieces: Booklet which describes do's and don'ts of industrial lubrication; Wall chart containing all booklet points in briefed form; Plant poster driving home value of proper lubrication; Industry folders with case histories of actual savings; Technical bulletins with engineering information on lubricating various types of industrial machinery. Sun Oil Co.

49 Floors Repaired While Traffic Rolls—Folder "Floor Patch" describes a product that repairs floors immediately and allows you to open the spot to regular traffic immediately. Floor patch is solid and permanent. This new plastic bonds tight to old concrete and withstands extreme loads. Flexrock Co.

50 Aluminum Imagineering Notebook —Thumb-tabbed in a new 28-pg notebook are details on the light weight, corrosion resistance, high electrical conductivity, non-sparking, and other properties of aluminum. Also pictures many power plant applications such as stacks, bus conductors, cable, rotors, switchgear housings, process tanks. Aluminum Co. of America.

51 Self-Cleaning Heat Exchanger — New Bulletin HE-100 describes design features and applications of Paracoil self-cleaning tubular heat exchanger. Less heat transfer surface, low initial cost, small physical dimensions are among advantages claimed. Davis Engineering Co.

52 Free Repair Handbook—Company offers free 40-pg guide for the use of Smooth-On cements, containing 170 diagrams and instructions for making lasting and economical repairs to plant equipment and machinery, pipe lines, fixtures, etc. Smooth-On Mfg. Co.

53 3-Dimension Pictorial Drawings—"Uses for Three-Dimension Pictorial Drawings," by J. A. C. Krips and W. S. Miller, outlines the advantages of such drawings in depicting shape and part relationship in one view, in planning manufacturing and assembly operations, and in taking the place of models. These drawings have also proved useful for determining clearances and possible interferences and in saving time in training new employees. Write for Bulletin 4311. I-T-E Circuit Breaker Co.

54 Industrial Lubrication Chart—New chart on Modern Industrial Lubrication contains helpful ideas on lubricating 139 different types of power and production equipment. Should be useful to operating and maintenance men. Adam Cook's Sons, Inc.

55 Industrial Type Unit Dust Collector — Features and construction specifications, together with the capacities and dimensions, of the new Pangborn Industrial Type "CK" Dust Collector, are covered by Bulletin No. 910. Of particular importance is the flexibility in arrangement permissible for adaptation to specific plant conditions. In three sizes with capacities to 1000, 2000 and 3000 cfm. Pangborn Corp.

56 Heat Protective Coating — New folder describes Hytemp coating for protection against high temperatures, acids, hot fumes, corrosion; also to resist adhesion of spatter in welding and brazing. Has chromic oxide base, resists temperatures up to 3500 deg F; applied by brush, spray or dipping; used on brick, metal and graphite surfaces. Geo. R. Mowat Co.

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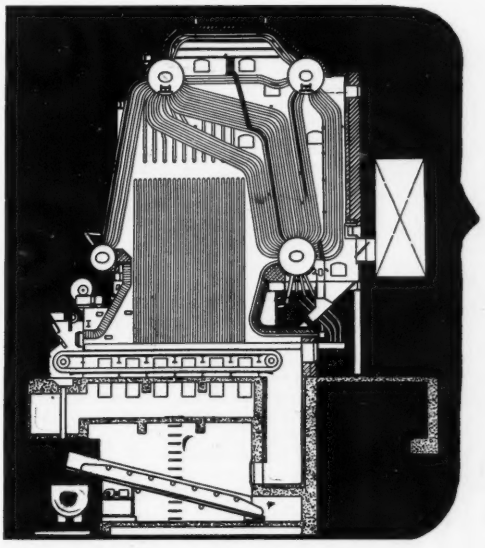

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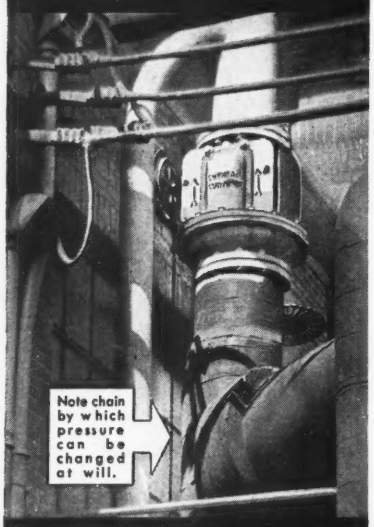

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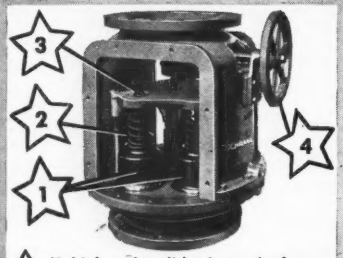

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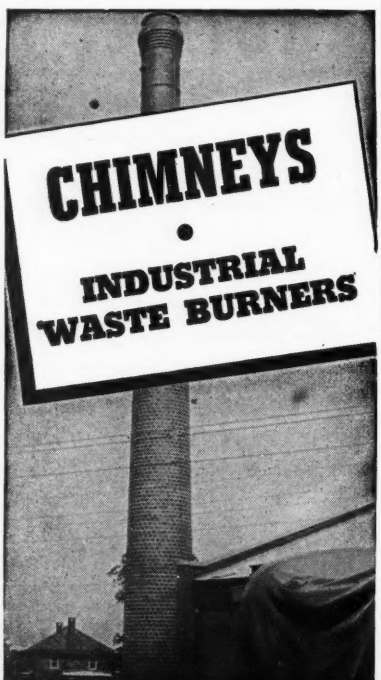
cable has been installed at voltage ratings from 15 kv to 45 kv," he reported. "No service failures have occurred and troubles have been limited to minor cases of gas leakage and some cases of sheath fatigue from severe cable movement."

Chemical Plant Expansion to Cost Over $5,000,000

E. I. DUPONT DENEMOURS & CO., INC., duPont Building, Wilmington, Del., is arranging an immediate and postwar plant expansion program in chemical and nylon divisions to cost in excess of $5,000,000. Company has concluded arrangements for purchase of San Jacinto shipyard property of U. S. Maritime Commission at La Porte, near Houston, Tex., with a large adjoining tract of land, totaling in all about 820 acres, to be used as site for new plant for Grasselli Chemical Division, primarily for manufacture of "phenothiazine," a synthetic chemical for eliminating parasites from livestock. Shipyard buildings will be remodeled and converted for plant service at early date, and a number of new structures erected. Electric power equipment will be installed for factory service, with power plant to be provided of required capacity for plant operations. Entire project is estimated to cost in excess of $2,000,000.

Kinetic Chemicals, Inc., a subsidiary of duPont company, with headquarters at first noted address, will begin work at once on new plant at East Chicago, Ind., for manufacture of a fluorine refrigerant to combat malaria mosquitoes. It will comprise several one- and multi-story processing and production buildings, with auxiliary structures for storage, distribution, etc. Electric power



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This chart has been issued as the third in a series of technical papers on Gaskets compiled by the Research Laboratory of the Goetze Gasket and Packing Company, Inc., oldest and largest manufacturers of industrial gaskets in America.

In requesting copies of this and succeeding issues of "The Gasket," write the company on your business letterhead, mentioning your position.

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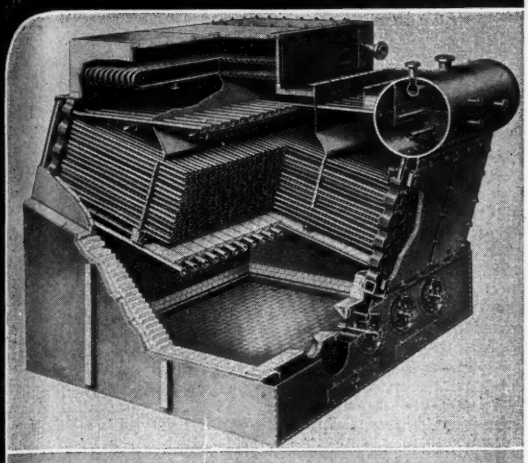

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equipment will be installed to provide for large output. General erection contract has been awarded to Krahl Construction Co., 350 N. Clark St., Chicago, Ill., and work is scheduled to proceed at once. Entire output will be used by Government, which has authorized financing in amount of $900,000 through Defense Plant Corp., Washington, D. C., Federal agency, for project.

Nylon Division of duPont company, first noted address, is concluding negotiations for purchase of a large tract of land in vicinity of Chattanooga, Tenn., with frontage on Tennessee River, to be used as a site for a new mill, to be carried out as a postwar project. Plant will consist of a group of one- and multi-story buildings for different departments of nylon and nylon yarn manufacture, with power plant and pumping station, and miscellaneous structures. It is reported to cost in excess of $2,000,000, with machinery. In conjunction with this development, company will carry out expansion in present nylon mills at Seaford, Del., and Martinsville, Va., with construction of new buildings, and installation of machinery and electric power equipment for large increase in present capacities. No estimate of cost has been announced for this part of program.

New Power Plant at San Antonio to Cost $2,000,000

CITY PUBLIC SERVICE BOARD, San Antonio, Tex., has work under way on a new municipal power plant, for which plans initially were projected a number of months ago and work discontinued with revoking of priority ratings by WPB; the Board recently has reinstated necessary priority for work to proceed. Plant will be known as Station B, of the municipal electric system. It will be equipped for a capacity of 20,000-kw, with a turbine-generator of this rating, high-pressure boiler and auxiliary equipment. Cost is estimated at $2,000,000. Plant is scheduled for completion during the summer. Gibbs & Hill, Pennsylvania Station, New York, N. Y., are consulting engineers for project, including supervision of erection.

New York State Electric to Build $3,000,000 Station

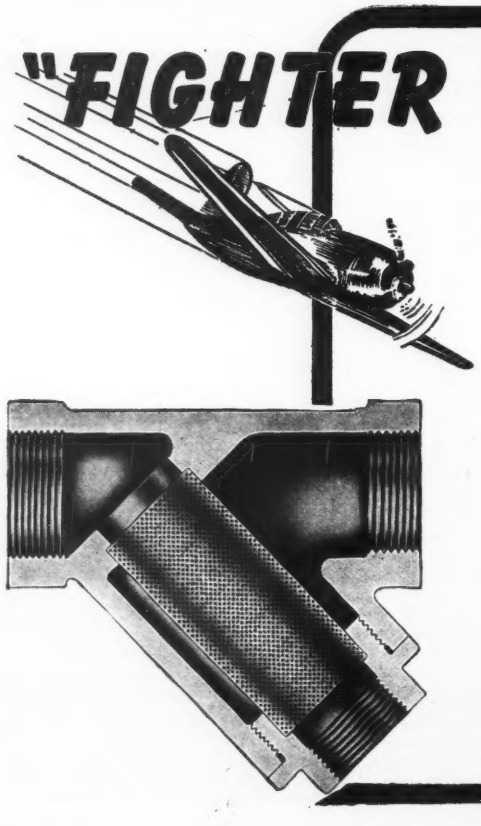
NEW YORK STATE ELECTRIC & GAS CORP., Ithaca, N. Y., is beginning preliminary work on new steam-electric generating station at Bainbridge (Chenango County), N. Y., for which a priority rating has been granted by WPB. Active construction on multi-story power plant is expected to begin at early date, as soon as contract is placed. Installation will include a turbine-generator and accessories, capacity not as yet announced, with high-pressure boiler and auxiliary equipment. Project will include extensions in transmission lines for connection with present high-tension system, switching station, power substation and other operating facilities. Plant will use coal as fuel, and contract has been awarded to Delaware & Hudson Railroad Co., for construction of a branch line to plant site, to be used primarily for coal handling service. Large storage facilities will be provided at station for fuel supply. Entire program is reported to cost about $3,000,000. It is understood that plant is scheduled to be ready for operation early in 1945. Gilbert Associates, Inc., 412 Washington St., Reading, Pa., is consulting engineer. Latter organization is affiliated with Atlantic Utility Service Corp., 61 Broadway, New York, N. Y., which acts in an advisory capacity for utility company.

Rayon Mill Expansion to Cost $7,000,000

AMERICAN VISCOSE CORP., Delaware Trust Bldg., Wilmington, Del., manufacturer of viscose rayon products, will carry out a large expansion program at three of its mills for increased production facilities for high-tenacity rayon, to be used for tire cord service. At mill at Lewistown, Pa., a number of new buildings will be erected, to cost approximately $4,000,000, with machinery and electric power equipment. Mill at Parkersburg, W. Va., will have a similar development program to cost $2,250,000, and plant at Marcus Hook, Pa., will be expanded at a cost of $750,000. Output will be for Government account, with financing in amount noted provided by Defense Plant Corp., Washington, D. C.

Spring Meeting of Society for Experimental Stress Analysis

THE SPRING MEETING of the Society for Experimental Stress Analysis including a Symposium on Residual Stresses, their Measurement, and Effects will be held at the Hotel Statler, Boston 17, Mass., May 18, 19, 20, 1944. Inquiries should be addressed to Society for Experimental Stress Analysis, P. O. Box 168, Cambridge 39, Mass.



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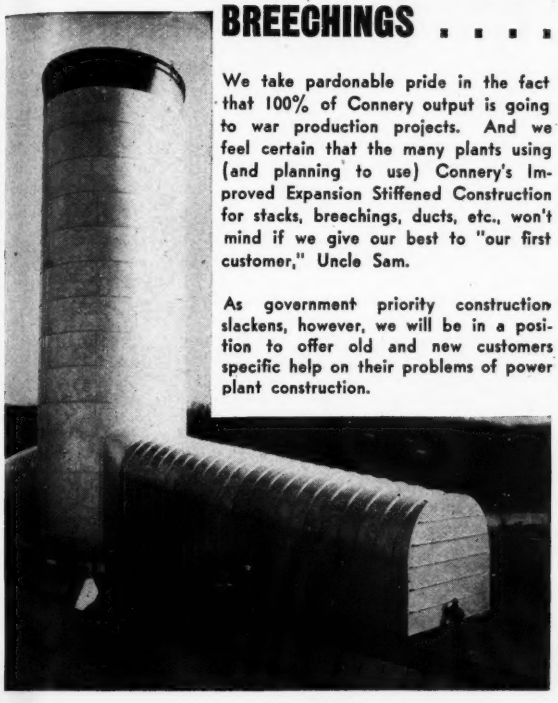

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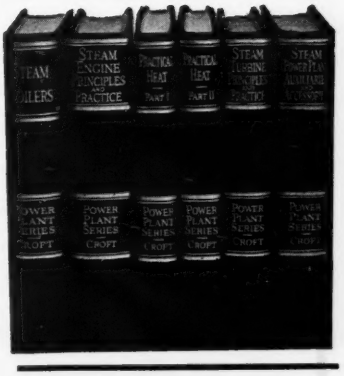
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NEW ENGINEERING BOOKS

To Discover Mathematics. By Gaylord M. Merriman. First edition, 435 p, illustrated, 6¼ by 9¼ in., cloth. Published by John Wiley and Sons, Inc., 440 Fourth Ave., New York, N. Y. 1942. Price $3.00.

During the past decade a great many books attempting to popularize mathematics have made their appearance. Some of these have been quite successful in creating popular interest but few of them were sufficiently different from existing books on mathematics to make them outstanding. In most instances they adhered to the same form of presentation that has characterized most textbooks on mathematics, with some popular language and a sprinkling of wisecracks thrown in to relieve the drudgery.

In this respect, this book by Professor Merriman is different. It is decidedly an outstanding book, as different from the conventional textbook as Wells' "Outline of History" was different from the history textbooks of that day. This is a book designed not so much to teach mathematics (though it does so admirably) as to expose its utility, its beauty and its philosophy.

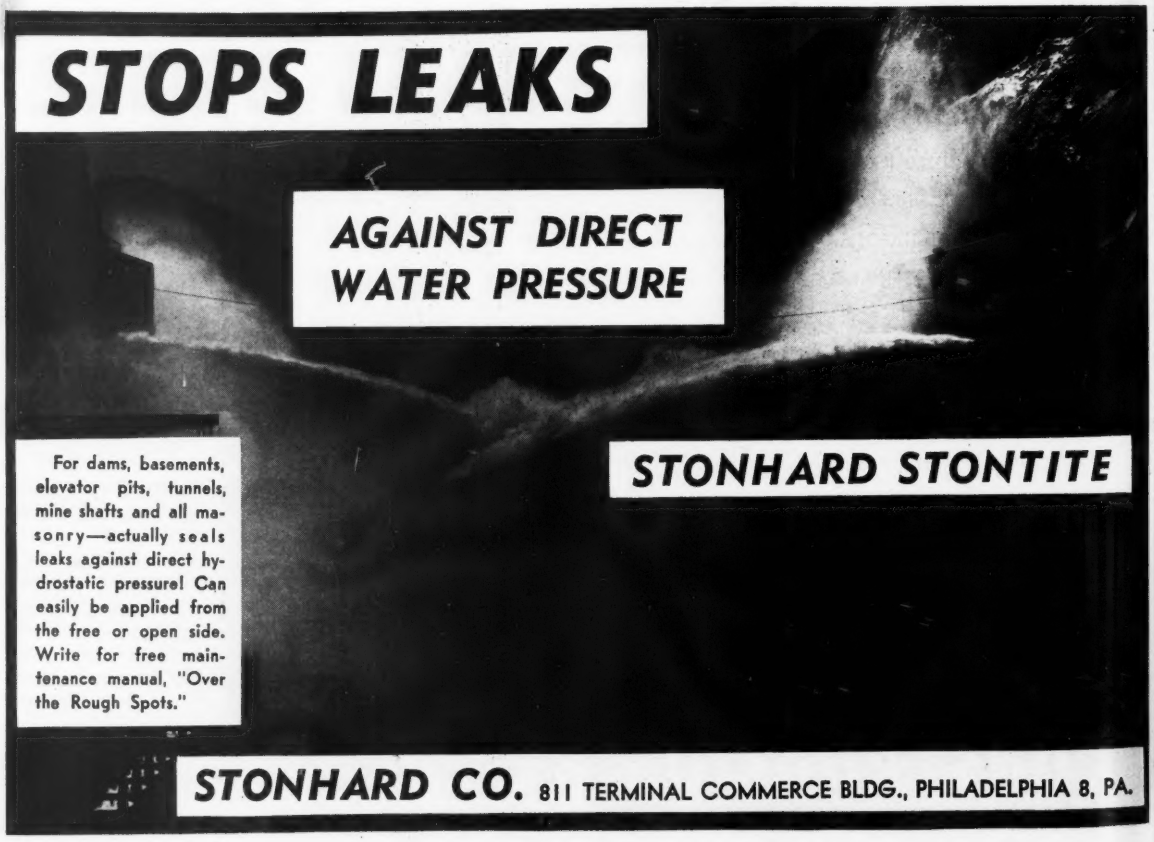
Quite naturally, as the author points out, a book of this character cannot be written in formal (and formidable) textbook style. Like other popular books on the subject, the style is chatty, the exposition often verging on the narrative. At all times, the reader is permitted to know the origin of the discussion and its goal. No phase of the subject seems to have been selected merely because it is always in books on mathematics but, as Mr. Merriman indicates, no important idea in elementary mathematics is dodged just because it is traditionally held to be too difficult for the uninitiated to understand.

Tradition in mathematical presentation has often erred in excessive compartmentalization and grading the material down to the presumed intellectual capacity of the reader. In most cases the material is presented in a rigid routine manner which under no circumstance can be deviated from. Calculus can not be "taken" without full working knowledge of algebra, trigonometry and analytical geometry, and these must be mastered in that order, though, as Mr. Merriman points out, the idea of calculus can be understood without any of the three. The result is, that many who would have found the ideas of calculus interesting and intriguing have been scared away from it because of the supposed "prerequisites." The price of prolonged apprenticeship is too severe, and to appreciate the aims of mathematics it is not necessary to pay the price.

If it is assumed that the fundamental ideas of mathematics should be a part of the fund of common knowledge of educated people, the question arises, can a book of reasonable length be written on the subject of mathematics that will have actual "content" or must it necessarily remain composed of those vague generalities that carry no conviction and defeat their own purpose? Professor Merriman's book supports the "content" side of this question. Basic material is selected; it is developed in homogeneous units either in single chapters or sequence of chapters with much attention to the interconnections so often neglected and so important to true mathematical appreciation. Although no attempt is made to employ a single unifying theme for the whole book (unless it be the beauty and charm of the subject), number and postulate and form dominate much of the first part, and the function and limit of concepts hold the spotlight in the latter part. The style of writing, admittedly a radical departure from the usual form of exposition in the average textbook, is chosen, as the author puts it, as an auxiliary to assimilation—not a sugar coating, but a digestive stimulant.

The author, who is Associate Professor of Mathematics at the University of Cincinnati has employed this style of class discussion in presenting the material required in a survey course in the College of Liberal Arts in the University of Cincinnati, where it has worked out well.

On the whole this is one of the most interesting books on mathematics that it has been the writer's pleasure to review in a long time and he feels that it will prove of value not only to engineers who should be interested in mathematics but to non-engineers as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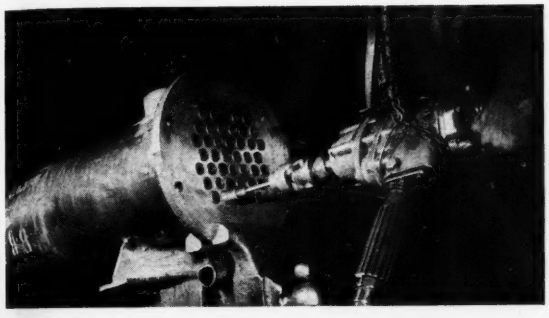

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Modern Turbines. Edited by Louis E. Newman. First edition, 175 pp, illustrated, 5½ by 8⅜ in., cloth. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y., 1944. Price $2.50.

This book, probably, gives more information in regard to steam turbines, in less space, and with greater clarity than any book ever published. It is a book for everybody even remotely interested in steam turbines. No matter whether you are a steam turbine operator, a teacher or student of power plants, a mechanical or electrical designer, a salesman selling power plant equipment, whether you think you know a great deal about turbines or not, this book will give you a better picture of the subject than you had before you read it. There is a good reason for this; the book was written by a group of specialists in turbine and turbine generator design who know as much about turbine design and operation as any similar group anywhere.

The greater portion of the book was written by Louis Newman of the turbine division of the General Electric Co., at Schenectady but a number of chapters were written by other specialists in the General Electric organization. Thus, the chapter on estimating turbine performance in terms of heat rate was written by Allen Keller of the turbine engineering department at Lynn, Mass. John M. Lyons of the turbine generator division at Lynn wrote Chapter IX on electric generators while L. B. Wales, also of the turbine engineering department at Lynn together with Mr. Newman, prepared the chapter on steam turbine governors. In each case, each author brought his knowledge of his own particular specialty to the subject.

The material in this book was first published in a series of articles in POWER PLANT ENGINEERING from September, 1937, to April, 1939. There were 18 articles in the original series, all of which were edited, revised and rearranged to form the nine chapters which make up the present book. An important addition has also been made; a complete index has been included and an appendix gives the NEMA recommended practices for turbine generators.

Of importance to small plant operators is the fact that the material in the book covers the range of ratings from 500 to 7500 kw inclusive, the turbines ordinarily used in industrial types of power plants and by small utilities.

It is written for engineers who are interested in the selection and application of the right turbine for the right job, but who do not wish to concern themselves with the intricacies of turbine design or of turbine maintenance. For these men the book provides a set of working tools. It provides them with the fundamental characteristics of turbines, whether they are simple condensing type units or the most complex extraction type units made.

Turbine-driven generators are covered in the detail required by the average application engineer. Those who are not electrical engineers will find Mr. Lyons' explanation of electrical stability, reactances, and time constants clear and easy to understand.

In short, this is a most excellent book, one that, in one compact volume, gives not only the essential basic information but the working tools for thoroughly understanding simple and complex turbines, their performance characteristics, how to select them for the most efficient and economical performance, and methods for quickly and accurately estimating steam performance without elaborate calculations. A. W. K.

Kinematics and Machine Design. By Louis J. Bradford and George L. Guillet. First edition, 357 pp, 5½ by 8 in., cloth. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y., 1943. Price $3.00.

Recent developments in technical instruction have created a need for shorter books combined with simpler treatment of a number of different subjects. This is particularly true in connection with courses in machine design. A great many people today are required to know some of the simpler facts and principles underlying machine design without being required to qualify as machine designers. Many courses in machine design have been brought forward recently which are shorter and more condensed than those formerly offered. Students taking these courses need to know the language of machine design, and the standard methods of designing ordinary machine elements and also, they should know something about the essentials of kinematics. It is not nec-

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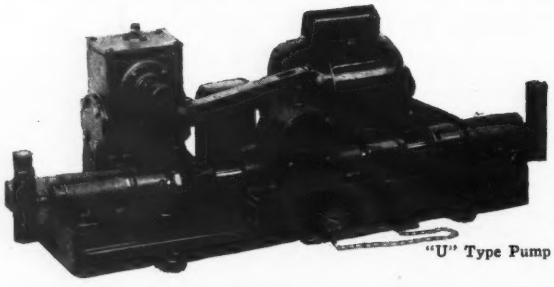

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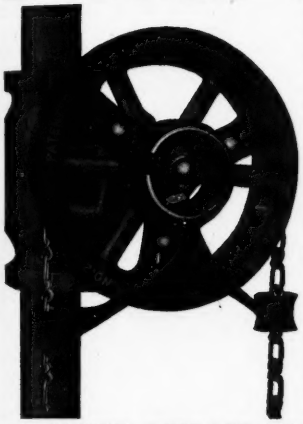

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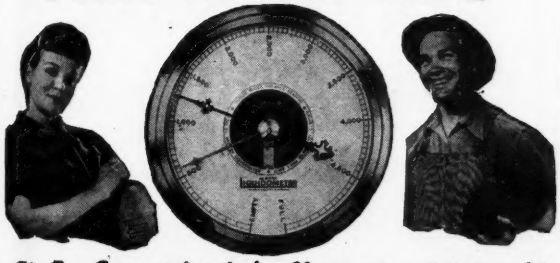

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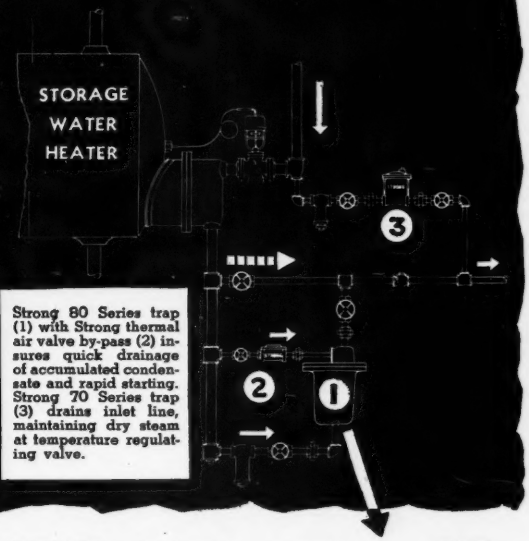

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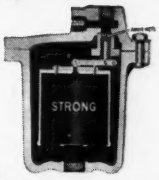

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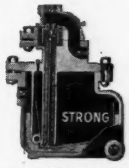

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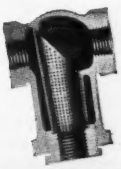

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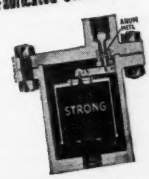

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essary that they know all the mathematical proofs lying behind the various equations they may have to use.

This book provides a text suited to such short combined courses. The first 78 pages of the book are devoted to the kinematics of machines and the remaining of the total 357 pages cover machine design. The book is, in fact, two texts in one. The authors abridged and consolidated two texts which have proved successful over a period of years in giving fundamental training to college students in mechanical, electrical and industrial engineering. These texts are Kinematics of Machines and Machine Design by the respective authors of the now combined book.

The book is clearly written with good illustrations and problems are given at the ends of many chapters for the student to work out.

Maintenance and Servicing of Electrical Instruments. By James Spencer. First edition, 256 pp, illustrated, 5 by 8¼ in., fabricoid. Published by Instruments Publishing Co., 1117 Wolfendale St., Pittsburgh, Pa., 1944. Price $2.00.

This book gives practical information on the maintenance and service of electrical indicating instruments. Strangely enough, this is a subject on which very little has been published in book form, and since this book makes its appearance at a time when there is a serious shortage of instruments, it should be of particular value now.

The author was for 15 years in charge of the Instrument and Relay Department of the Meter Division of Westinghouse Electric and Manufacturing Co., at Newark, N. J., and thus brings to the readers of his book a wealth of specialized knowledge and experience.

Originally, much of the material had been prepared as a guide for teaching the subject in industrial electrical schools and for training personnel for instrument manufacture. Because of the war, however, and the many new applications for electrical indicating instruments, the guide information was amplified and put into the present book form.

The book is clearly written. Each general type of instrument in common use is first covered with a simple explanation of the underlying principle of operation, and then followed up by detailed instructions on maintenance and repair.

The volume should be useful to all instrument users, switchboard attendants, testing engineers, and instrument service men, as the accuracy and efficient life of instruments depends to a large extent upon intelligent handling.

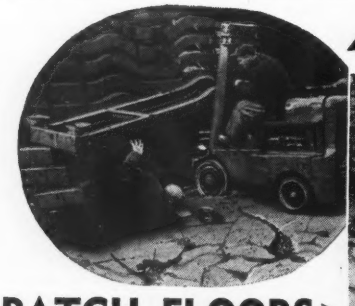
Fundamentals of Vibration Study. By R. G. Manley. Size 5½ by 8½ in.; 128 pp, cloth binding. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price $2.75.

This book is designed to serve as an introduction to the subject and attention has been confined to the basic theory. The author of the Vibration Department, De Havilland Aircraft Co., says that no previous knowledge of differential equations is assumed, this troublesome part of the theory being dealt with by the powerful and easy method of operators; indeed, the only mathematical equipment is that which should be at the command of anyone who has gone but a little way beyond the matriculation syllabus.

Now this may seem quite elementary to engineers in Great Britain. Unfortunately, however, our observation is that only a relatively few practicing engineers in this country know enough mathematics to use this book as an introduction to the subject. For those who do, Mr. Manley really does get down to the fundamentals of vibration, because it is not possible to discuss them except in mathematical terms.

The most important advance in recent years in vibration theory, he says, has been the development of the concept of effective inertia with its collateral mechanical impedance, termed dynamic stiffness for reasons stated in the text. These methods of attack have been used with conspicuous success in the treatment of torsional vibration, particularly in aircraft applications. An entirely new approach to the idea of effective inertia is described in the text—an approach which, besides being direct, has been tried out with students and is evidently easily grasped. Emphasis is given to resonance, which is the really significant phenomenon for the engineer.

The book is divided into the following chapters: Systems Having One Degree of Freedom (Undamped Motion); Damping and Forced Vibration (One Degree of Freedom—continued); Undamped Motion with Two Degrees of Freedom; Many Degrees of Freedom (Effective Inertia and Dynamic Stiffness); Continuous Systems (Heavy Shafts and Beams); Complex Vibrations (Fourier Analysis).



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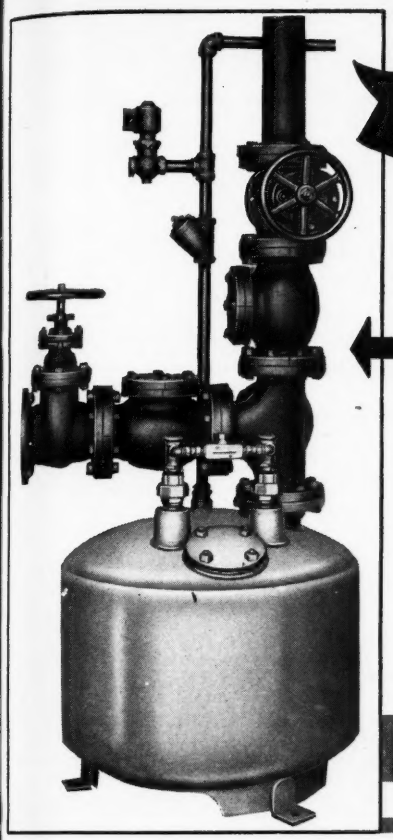

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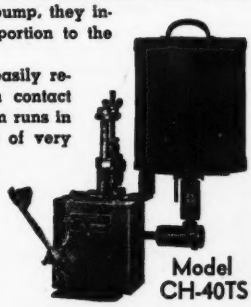

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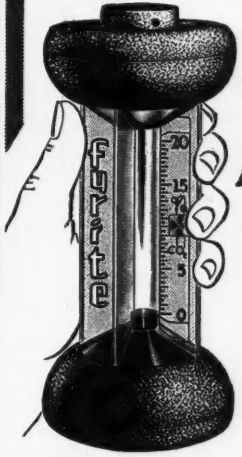

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Power Plant Construction News

Ark., Berryville—Carroll Electric Cooperative Corp. plans extensions in power lines in part of Carroll County, including line tansformers, service connections and other operating facilities. Cost about $50,000. Financing has been arranged through Federal aid.

Calif., Los Angeles—Navy Dept., Washington, D. C., has approved plans for new electrical and optical shop at Roosevelt Base, Terminal Island, Los Angeles, estimated to cost about $628,000, with equipment. Work is scheduled to begin at once and will be carried out by Officer in Charge of Construction, Roosevelt Base.

Fla., Jacksonville—Bureau of Yards and Docks, Navy Dept., Washington, D. C., has authorized extensions and improvements in steam distribution system at Naval Air Station, Jacksonville, estimated to cost about $389,000. Appropriation in that amount has been approved. Bids are scheduled to be asked at early date.

Ga., Atlanta—Board of Trustees, Georgia School of Technology, plans extensions and improvements in boiler plant at institution, with installation of additional equipment for increased capacity, as part of a postwar program. A number of new buildings are proposed, entire project to cost about $1,200,000.

Ind., Whiting—Board of Public Works, City Hall, plans installation of a number of motor-driven pumping units of large capacity in connection with a new sewage treatment plant, to be carried out as a postwar project. Cost estimated close to $1,000,000. Consoer, Townsend & Associates, 211 West Wacker Dr., Chicago, Ill., are consulting engineers.

Iowa, Corning—Adams County Cooperative Electric Co., Corning, plans extensions in power lines in Adams County, including service connections and other operating facilities. Cost estimated about $70,000. Financing has been arranged through Federal aid and work is scheduled to begin soon.

Iowa, Des Moines—Spencer Kellogg & Sons, Inc., Niagara Sq., Buffalo, N. Y., manufacturer of linseed oil, soybean oils, etc., plans installation of electric power equipment in new soybean oil mill at Des Moines. Entire project is reported to cost close to $300,000. Work will begin at early date.

Ky., Lebanon—Associated Kentucky Distilleries Co., Breckinridge and 17th Sts., Louisville, Ky., plans addition to boiler plant at distillery at Lebanon, now in production for commercial alcohol for Government, including installation of equipment for increased capacity. Work will be carried out in conjunction with other expansion at plant, entire project to cost about $150,000, with financing by Government. Carl J. Kiefer Associates, Inc., 26 East 6th St., Cincinnati, Ohio, is consulting engineer.

Md., Baltimore—Revere Copper & Brass, Inc., Baltimore Division, 1301 Wicomco St., Baltimore, manufacturer of brass, copper, aluminum and other light metal products, will carry out expansion in local plant for increased capacity for Government, including new buildings and machinery. Electric power equipment will be installed. Project is estimated to cost approximately $900,000, and will be financed by Defense Plant Corp., Washington, D. C. Work is scheduled to begin at once.

Mich., Detroit—Continental Motors Corp., 12801 East Jefferson Ave., Detroit, Mich., manufacturer of aircraft and automobile engines, will make extensions in branch plant at Garland, for production for Government, including new buildings and machinery for large increased output. Electric power equipment will be installed. Project will cost about $600,000, and will be financed by Government. Proposed to begin work at once.

Minn., Rochester—Municipal Public Utility Board has engaged Sargent & Lundy, 140 S. Dearborn St., Chicago, Ill., consulting engineers, to make surveys and estimates of cost for proposed expansion in municipal light and power facilities, including contemplated extensions in municipal steam-electric generating station. It is understood that recommendations will be carried out as a postwar development.

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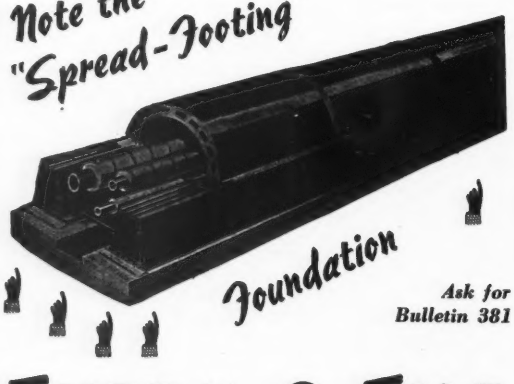

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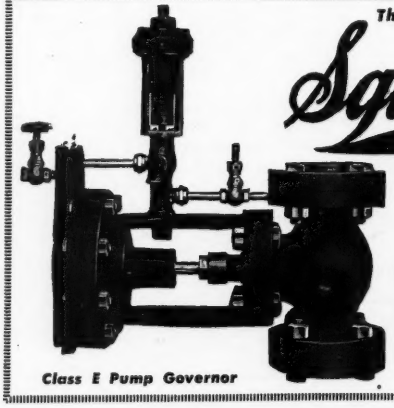

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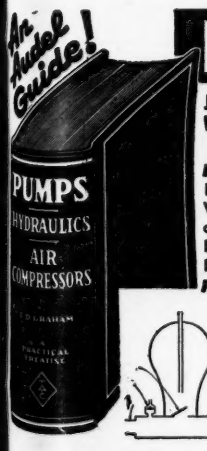

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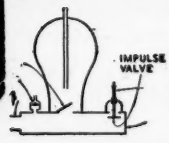

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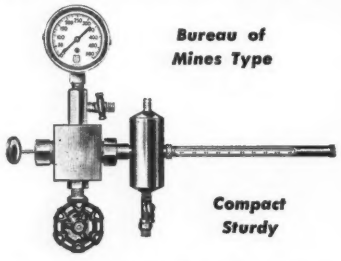

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Minn., Roseau—Land O'Lakes Creameries, Inc., 2301 Kennedy St., N. E., Minneapolis, Minn., plans installation of electric power equipment in new milk dehydrating plant at Roseau, where site has been acquired. A boiler house is planned. Entire project is reported to cost close to $80,000. Application is being made for a priority rating. Max O. Buetow, 1931 University Ave., St. Paul, Minn., is architect.

N. M., Carlsbad—United States Potash Co., Carlsbad, plans installation of electric power equipment in connection with expansion in plant, including several additional buildings for production and refining. Entire program will cost approximately $1,000,000, and will be placed under way soon. Executive offices are at 30 Rockefeller Plaza, New York, N. Y.

Pa., Philadelphia—Continental Distilling Corp., 1429 Walnut St., plans addition to boiler plant at local distillery, Front and Federal Sts., with installation of boilers and other equipment for increased capacity. A new distillery unit also will be built, to be used for commercial alcohol production for Government. Electric power equipment will be installed. Entire project will cost about $2,000,000 and will be financed by Government. United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia, is engineer.

Pa., Quakertown—Mycalex Corp. of America, Inc., 30 Rockefeller Plaza, New York, N. Y., manufacturer of mica insulating products, plans installation of electric power equipment in new plant at Quakertown, for production for Government. A power substation is proposed, as well as boiler house. Entire project will cost about $600,000, with financing provided by Defense Plant Corp., Washington, D. C., Federal agency. Work will be carried out soon.

R. I., Newport—Bureau of Yards and Docks, Navy Dept., Washington, D. C., plans extensions and improvements in power plant at Naval Torpedo Station, Newport, with installation of additional equipment for increased capacity. No estimate of cost announced. Work is scheduled to be carried out soon.

S. C., Bennettsville—Marlboro Electric Refrigeration Cooperative, Inc., Paul A. Wallace, president, recently organized, has plans under way for new one-story refrigerating plant, with locker system, reported to cost close to $40,000, with equipment. Local site has been acquired. Application has been made for a priority rating.

Tenn., Cookeville—American Houses, Inc., 570 Lexington Ave., New York, N. Y., manufacturer of prefabricated wooden dwellings, plans early construction of new plant at Cookeville, where site has been acquired, to be one-story, about 75 x 200 ft, with several smaller structures. Electric power equipment will be installed. A boiler house is planned. Entire project is reported to cost close to $100,000. It is understood that a priority rating has been secured.

W. Va., Parkersburg—Universal Glass Products Co., manufacturer of milk bottles, jars, etc., plans installation of electric power equipment in connection with proposed rebuilding of plant, recently destroyed by fire, with loss reported in excess of $100,000, including machinery. Planned to make application for a priority rating at early date.

Wis., Union Grove—State Dept. of Public Welfare, Madison, Wis., has authorized new boiler plant for central-heating service at Southern Colony and Training School, Union Grove. Also for extensions and improvements in heating system and water supply system. Entire project is estimated to cost $145,000, and will be carried out as soon as equipment and materials are available. Roger C. Kirchhoff, State Capitol, Madison, is state architect.

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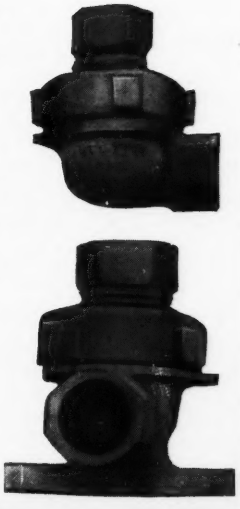

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Allpax Co., Inc., The.....170
American Blower Corp. 24-25
American Chain & Cable Co., Inc...120
American Chimney Corp. 188
American Coal Burner Co.....140
American District Steam Co. 193
American Engrg. Company ..... *
American Locomotive Co. (Alco Products Division).....147
American Pulverizer Co. ..... *
American Radiator & Standard Sanitary Corp. 24-25
Anderson Co., The V. D. ..... *
Anderson-Stoltz Corp. 172
Arkansas Fuel Oil Co. 56
Armor-Clad Company ..... *
Armstrong Machine Works..... 45
Atlas Valve Co. ..... *
Audel & Co., Theo. 199

Babbitt Steam Specialty Co. 195
Babcock & Wilcox Co., The.....18-19
Babcock & Wilcox Tube Co., The... *
Bacharach Ind. Inst. Co. 197
Bailey Meter Co. 14
Baldwin-Hill Co. 142
Baldwin Locomotive Works.....119
Beaumont Birch Company..... *
Belmont Packing & Rubber Co., The.150
Bendix Aviation Corp. 176
Betz, W. H. & L. D. 115
Biddle Co., James G. 136
Bird-Archer Co., The ..... *
Blackmer Pump Co. ..... *
Bowser, Inc. 157
Brickseal Refractory Co. 182
Bridgeport Brass Co. 130B
Brown Instrument Co., The..... *
Brunt Equipment Co. ..... *
Builders-Providence, Inc. ..... *
Burgess-Manning Co. ..... *
Busch-Sulzer Bros. Diesel Engine Co.163

Canton Stoker Corp. 42-43
Cash Company, A. W. ..... *
Chapman Valve Mfg. Co., The .....Inside Back Cover
Chesterton Co., A. W. 174
Chicago Metal Hose Corp. 154
Cities Service Oil Co. 56
Cleaver-Brooks Co. 183
Clipper Mfg. Co., The.....189
Coal Bureau—Upper Monongahela Valley Association 161
Cochrane Corporation 49, 130A, 188
Combination Pump Valve Co. ..... *
Combination Control Corp. ..... *
Combustion Engrg. Co., Inc. 22-23
Condenser Service & Engineering Co., Inc. 133
Connery Construction Co. 191
Cook's Sons, Inc., Adam..... *
Coppus Engrg. Corp. ..... *
Corning Glass Works 164
Crane Co. 109
Crane Packing Co. 52
Crocker-Wheeler Elec. Mfg. Co. .... *
Cutler-Hammer, Inc. .....Back Cover

Dampney Company of America, The.137
Dart Mfg. Co., E. M. 138
Davis Regulator Co. ..... *
Dean Hill Pump Co. ..... *
Dearborn Chemical Co. ..... *
De Laval Separator Co., The..... *
De Laval Steam Turbine Co. ...32, 184
Detrick Co., M. H. 127
Detroit Stoker Co. 16-17
Dowell, Incorporated 153

Edge Moor Iron Works, Inc. 169
Edward Valve & Mfg. Co., Inc., The.107
Electric Chemical Co. ..... *
Elgin Softener Corp. 58
Elliott Co. 2-3
Engineer Co., The 180
Ernst Water Column & Gage Co. ...199
Ess Instrument Co. 199

Fairbanks Co., The 122
Fisher Governor Company..... *
Flexitallic Gasket Co. 159
Flexrock Co. 196
Flynn & Emrich Co. 155
Foster Engrg. Company 126
Foster Wheeler Corp. 36-37
France Packing Co., The.....184
Fuller Company ..... *

Garlock Packing Co., The..... *
Garratt-Callahan Co. 201
General Coal Co. ..... *
General Electric Co. 38-39, 121, 129
Gifford-Wood Co. 158
Gilmer Company, L. H. ..... *
Globe Steel Tubes Co. 124
Goetze Gasket & Packing Co., Inc...188
Golden-Anderson Valve Specialty Co.132
Grinnell Co., Inc. ..... *
Griscom-Russell Co., The..... 33

Haering & Co., Inc., D. W. 178
Hagan Corporation 12-13, 20-21
Hall Laboratories 12-13, 20-21
Hays Corporation, The.....111
Hendy Iron Works, Joshua.....123
Henszey Company 148
Hercules Float Works 198
Hills-McCanna Co. 194
Honan-Crane Corp. ..... *
Huyette Co., Inc., The Paul B. .... *

Infilco, Incorporated 167
Ingersoll-Rand Co. ..... *
International Nickel Co., Inc., The. 48
Iron Fireman Mfg. Co. 59

Jenkins Bros. 139
Johns-Manville ..... *
Johnson Service Company..... *

Kellogg Co., The M. W. 151
Kennedy Valve Mfg. Co., The.....130
Kieley & Mueller 190

Ladish Drop Forge Co. 53
Leeds & Northrup Company..... 34
Link-Belt Co. 181
Liquidometer Corp., The.....195
Lummus Co., The 50
Lunkenheimer Co., The.....105

Manzel Bros. Co. 197
Marley Company, Inc., The..... *
Mason-Neilan Regulator Co. ..... *
Maxim Silencer Company, The..... 6
McAlear Manufacturing Company..173
McGraw-Hill Book Co., Inc. 191
Midwest Piping & Supply Co., Inc..149
Miller Tool Sales, J. C. ..... *
Minneapolis-Honeywell Regulator Co. ..... *
Murray Iron Works Co. 166

National Aluminate Corp. 103
National Valve & Mfg. Co. 128
Niagara Blower Co. 152
Nicholson & Co., W. H. 176
Northern Equipment Co. 113
Norton Company ..... *
Nugent & Co., Inc., Wm. W. 201

Oakite Products, Inc. 180
Ohio Injector Co., The..... *

Pennsylvania Crusher Co. 196
Permutit Co., The..... *
Philadelphia Gear Works.....175
Pipe & Tube Products, Inc. 162
Porter Co., Inc., H. K. 168
Porter & Co., Inc., H. W. 198
Powell Co., The Wm. 135
Powers Regulator Co., The..... *
Prat-Daniel Corp. ..... *
Pritchard & Co., J. F. 55
Proportioneers, Inc. ..... *

Quaker Rubber Corporation..... *
Quimby Pump Co., Inc. 168
Quinn, Frank D. ..... *

Raybestos-Manhattan, Inc. 146
Reading-Pratt & Cady Div. of American Chain & Cable Co., Inc. 120
Refinery Supply Co., Inc. 200
Reliance Gauge Column Co., The.... 51
Rempe Co. ..... *
Republic Flow Meters Co. 30
Richardson Scale Company..... *
Roto Company, The.....170
R-S Products Corp. 144

Sarco Company, Inc. 171
Scovill Mfg. Co. 26-27
Shell Oil Co., Inc. 9
Simplex Valve & Meter Co. 54
Sims Company, The.....178
Skinner Engine Co. ..... *
Smooth-On Mfg. Co. 189
Socony-Vacuum Oil Co., Inc. 15
Springfield Boiler Co. ..... *
Squires Co., The C. E. 198
Steel Improvement & Forge Co. ...141
Stephens-Adamson Mfg. Co. 47
Stonhard Co. 192
Strong, Carlisle & Hammond Co...195
Struthers Wells Corp. 143
Superior Railway Products Corp....201
Sun Oil Company..... *
Swartwout Co., The.....168
Syntron Company ..... *

Talon, Inc. ..... *
Taylor & Co., W. A. 184
Taylor Forge & Pipe Works.....131
Terry Steam Turbine Co., The..... 35
Texas Co., The..... 4
Tide Water Associated Oil Co....40-41
Todd Shipyards Corporation (Combustion Equipment Division).... *
Treasury Department ..... *
Troy Engine & Machine Co. 177
Tube-Turns, Inc. 117

Union Iron Works.....187
U. S. Machine Corp. ..... *
United States Rubber Co. 4
Union Asbestos & Rubber Co. ..... *

Viking Instruments, Inc. 182
Vogt Machine Co., Inc., Henry..... 46

Wabash Portland Cement Co. 200
Warren Steam Pump Co., Inc. 165
Water Treatment Co. of America..156
Watson-Stillman Co., The..... *
Westinghouse Elec. & Mfg. Co. 125
Wheeler Mfg. Co., C. H 57
Wickes Boiler Co., The.....197
Wiley & Sons, Inc., John..... *
Williams Gauge Co., The..... *
Williams Valve Co., The D. T. 200
Wilson Co., Thos. C. 160
Wing Mfg. Co., L. J. 179
Worthington Pump & Machy. Corp. 31

Xzit Sales Corp. ..... *

Yarnall-Waring Co. 10-11, 60, 134
Yeomans Bros. 197
Young Radiator Co. ..... *

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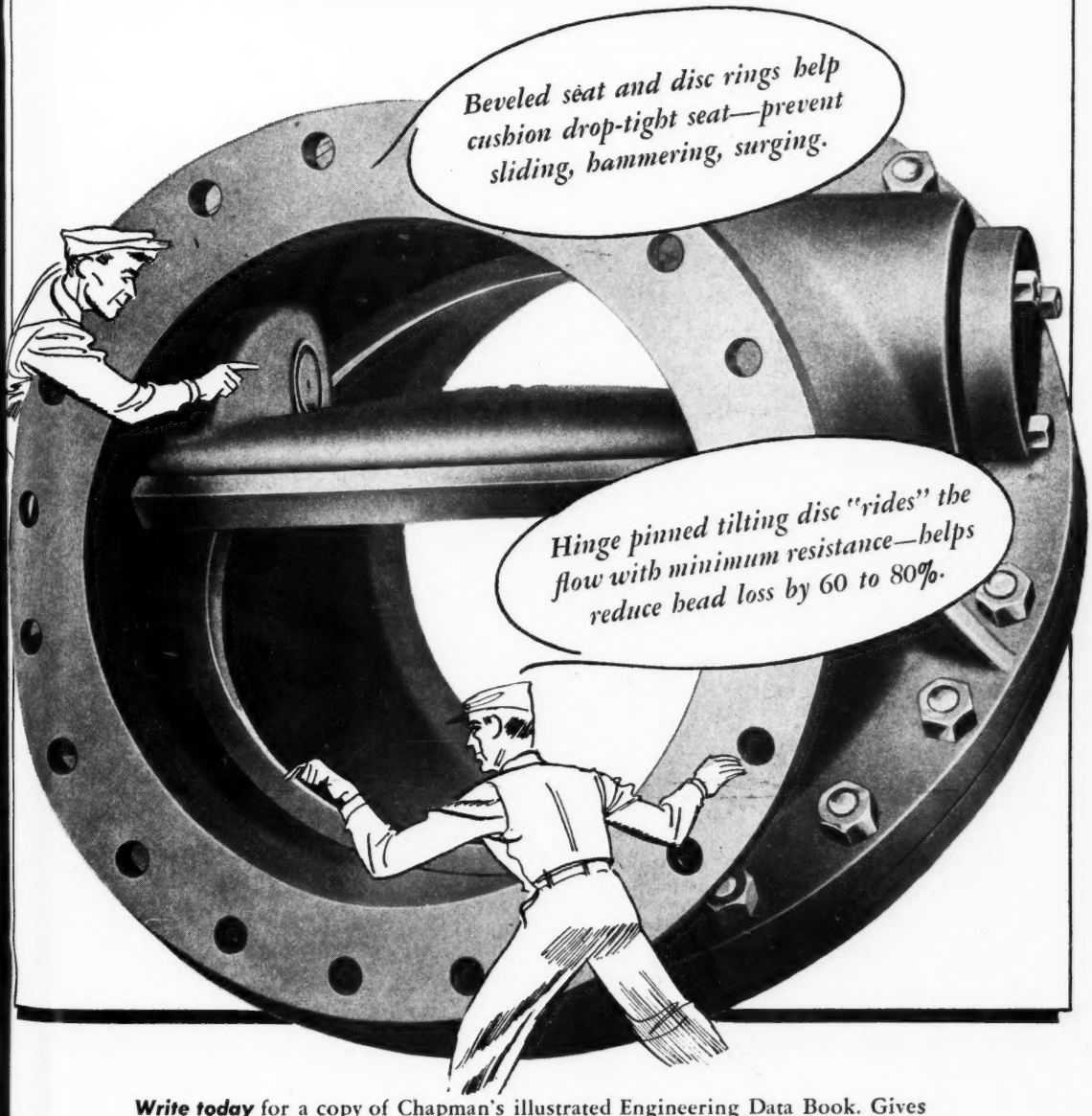
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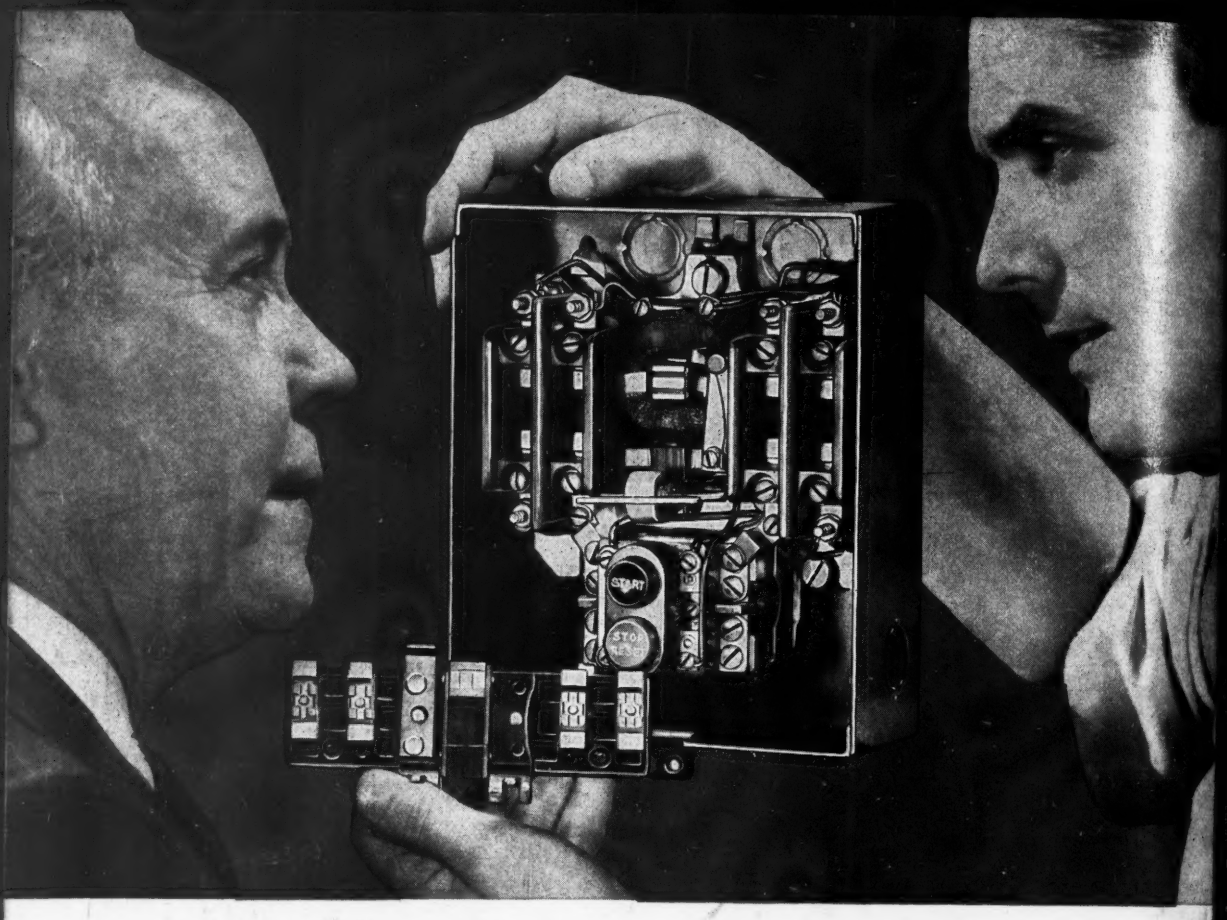

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